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SPEEDING UP FRANCE'S CANAL TRAFFIC WITH THE ELECTRIC MULE.—[See page 229]

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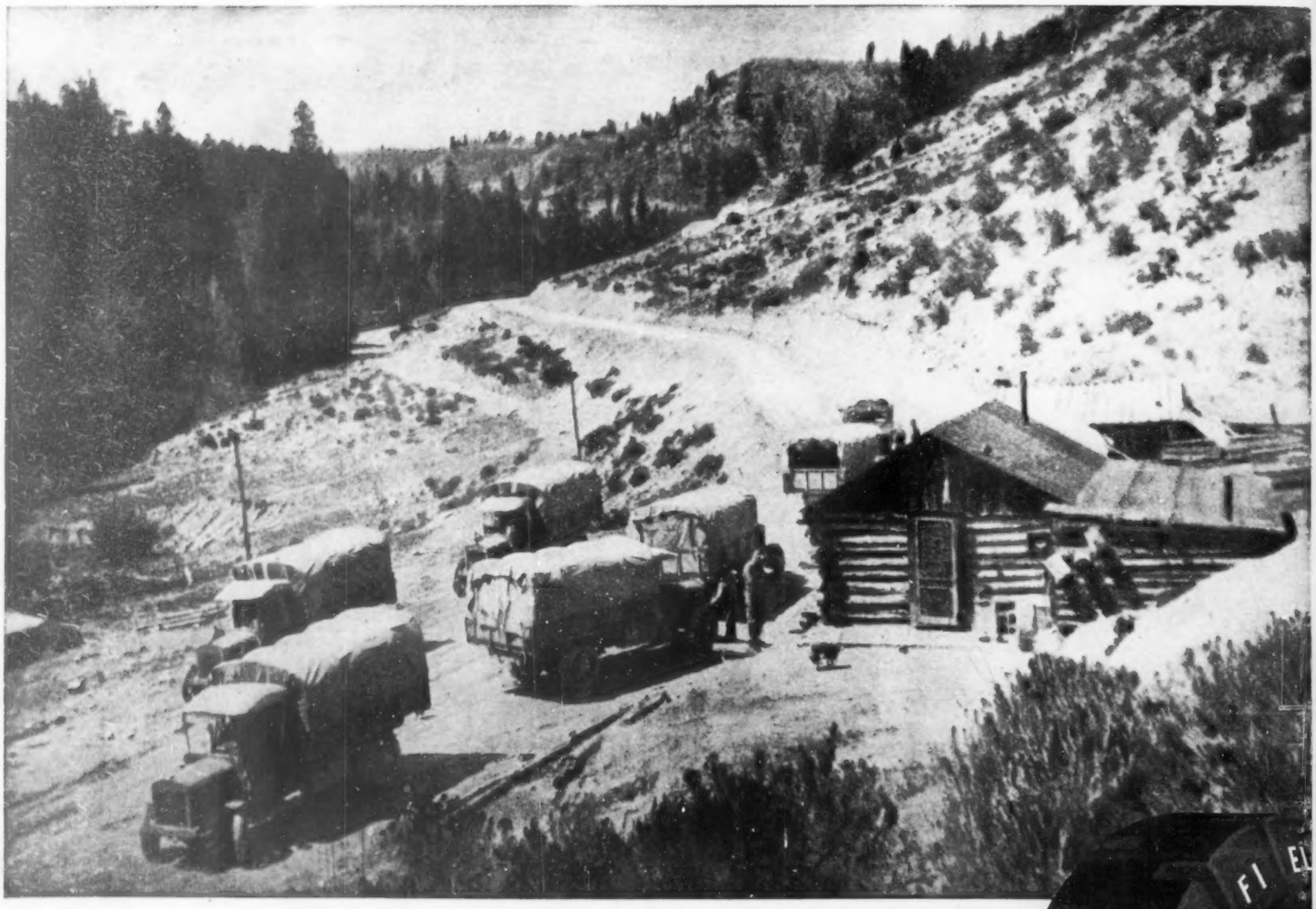

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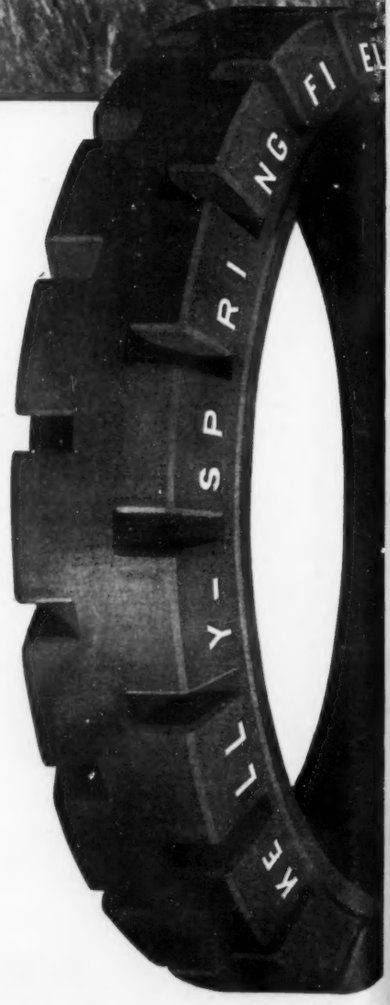

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BIRD'S-EYE VIEW OF THE PORT OF NEW YORK, SHOWING BELT LINES AND MERCHANDISE TUNNEL RECOMMENDED BY THE JOINT PORT COMMISSION—[See page 224]

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Hudson River Bridge or Tunnel—Which?

THE report of the New York-New Jersey Port and Harbor Development Commission, whose plans are illustrated and described elsewhere in this issue, would have been a masterly document were it not for one very serious defect. Its plans for coordinating all the railroad and dock facilities of the port by means of a system of belt railroads are comprehensive and in agreement with the best judgment of the railroad, shipping and port authorities of the day. But when it comes to the question of how best to overcome the great natural obstacle presented by the North River—the one absolute fundamental in the whole question—the Commission seems to have lost its breadth of vision, and fallen into the popular error of believing that, as a great thoroughfare for traffic, a tunnel can compete with a bridge.

Not only does the Commission recommend a tunnel, with its limited capacity, but it bespeaks the operation of this tunnel by an entirely new system of automatic, crewless trains, which has never been tried out on a large scale, and therefore will be experimental in character. Furthermore, this proposed system is to be utilized for a limited portion only of the freight that comes to New York, namely, that of food and general merchandise.

That the system is ingenious, and that it would probably do all that is claimed for it we do not deny; but what we do claim is that food and general merchandise form, at best, only a limited part of the total freight that has to be handled at this port. The tunnel is not designed to handle bulk freight. It makes no provision for coal, or wheat, or heavy machinery, and, most serious omission of all, it is not designed to transport a single passenger, either long distance or suburban; nor will it serve for the passage of a single automobile or motor truck across the North River.

In short, the report, which starts out with a wide survey of the problem and an apparent grasp of the multifarious nd many-sided character of the traffic situation, leads the expectant citizen into one corner of the problem and there leaves him. The resident of Manhattan is told that he may have a quicker and cheaper delivery of his food, shoes and clothes, if he will foot a bill of $201,190,000, which is what a food-and-clothes-carrying tunnel *for lower Manhattan only* will cost. An enlarged tunnel system, to serve all Manhattan, would probably cost $400,000,000.

And how about a bridge as a solution of this same food-and-clothes problem? What would it cost and how much could it carry? The cost, including a classification yard in the Jersey meadows, a system of truck delivery from railroad cars in Jersey direct to store door in Manhattan, and a marginal elevated standard-gage railway down the west side, would be the same: $200,000,000. The capacity for freight by motor truck alone would be over 200,000 tons per day, as against the maximum of 50,000 tons per day claimed by the Commission for the tunnel. For it must be remembered that, as against the two tracks in the tunnel, we have on the 140-foot upper-deck roadway of the bridge room for 14 ten-foot separate vehicle tracks for motor trucks. It is evident then, that in its own restricted field of food and general merchandise traffic, the tunnel is outmatched four to one by the bridge.

But carrying general merchandise will form but a part, and a relatively small part, of the service rendered. Because of its vast size the bridge will have four tracks on its upper deck and eight standard railroad tracks on its lower deck, besides two tracks for a traveling platform. Let us consider, then, what this means in the way of service additional to that which can be rendered by the tunnel.

In the first place, a carload of freight can be shipped from New Orleans, St. Louis or Chicago direct to the ship's side at a Manhattan, Bronx or Brooklyn dock without any handling except from car to ship. In the second place, through express trains, no matter over what line they arrive, can be run across the bridge to a Union station in Manhattan. A third advantage is that suburban passengers will be carried from Jersey towns direct to Manhattan. Similar through service will be available by the trolley car systems. Lastly, the bridge will afford a continuous highway for the vast automobile and motor truck traffic to and from Long Island, the Bronx, Manhattan and New Jersey.

There can be no choice between a bridge and a tunnel. The above considerations prove to a demonstration that for the some outlay of $200,000,000 the service rendered respectively by a North River bridge and a North River tunnel will be on the ratio of—well—something like ten to one.

Our Merchant Fleet and Free Ports

THE possession of a great fleet of ships does not in itself constitute a successful merchant marine. Unless these vessels are so wisely routed and operated that they are fairly well filled on both the outward and return trips, they cannot become a profitable investment. There is probably no commercial enterprise which is so specialized and calls for such broad knowledge based upon experience and a careful study of the operations of successful competitors as the shipping business, and particularly that part of it which is concerned with foreign trade.

As everyone knows, our supreme wartime effort to counterbalance the submarine sinkings by an enormous output of shipping has left us in the possession of the second greatest merchant fleet in the world. We have the ships, and now the problem before us is to build up by every legitimate means a foreign trade, incoming as well as outgoing, which will keep our merchant fleet in full operation. The subject is a vast one, and we intend, just here, to speak merely of one very important phase of it, namely, that of the creation at our principal shipping centers of what are known as "free ports."

A free port is a zone or district which is excluded from the operation of a country's customs regulations. It is equipped with docks, piers, pier sheds, warehouses, and all the facilities for the loading and unloading of ships and the temporary storage of their cargoes. Also, within its strictly defined boundaries will be found various industrial establishments in which the raw materials that are unloaded in the free port may be worked up into various finished products. The advantages of such an institution are many. Cargoes which are brought to the port for reshipment to points outside of the country do not have to pay duty, and they save the time and expense of haulage to warehouses in the city. Instead of this, they are unloaded and stored in free-port warehouses adjacent to the docks, and can be reshipped abroad without the delay and expense of passage through the customs. Similarly, raw materials which ordinarily would have to pay duty can be brought to the free port, worked up into finished products, and exported free of duty. If any part of the material so manufactured is destined for home consumption, the duties are paid when they pass the free port boundaries.

The free port is no experiment. Its manifold advantages have been proved in several of the leading ports of Europe, notably at Hamburg, which is a model of its kind. Copenhagen, Stockholm and Christiania have all been set aside as free ports by their governments. Because of her free trade policy, the whole of England is one free port, and the beneficial results of the policy as worked out in that great maritime country are too well known to need any elaboration here.

In an illuminating article written by Edward N. Hurley for the Bureau of Economics, which has been founded for the study of California's public service industries, the advantages of free ports are stated very forcibly. He draws attention to the fact that this country is an importer of foreign-made products which could well be assembled in a free port territory, both for sale in our own customs territory and for reshipment free of customs to other countries. The development of such industries would create not only an addition to the industry itself, but would tend to transfer to our own ports manufacturing and assembling, which would otherwise continue to be done abroad to the benefit of foreign labor and foreign capital. Everyone who takes a thoughtful and comprehensive view of the years of sharp commercial competition among the nations, which lie ahead of us, will agree with him that the United States Government should place American business upon the same competitive footing as that enjoyed by those protective tariff nations which have free port and free zone advantages.

We are glad to note that in the report of the New York-New Jersey Port and Harbor Development Commission a plea is made for the construction of one or more free-port districts at New York. A study has been made by commercial interests of the operation of free ports abroad and legislation has been introduced in Congress looking toward the establishment of such in this country. Investigations have been made also by Federal boards to determine the sentiment of this country toward the free-port project. The advantages of the system are so marked and so many that, once the people of this country become familiarized with the idea, there cannot fail to be a demand for the creation of free ports not merely at New York, but at all the leading seaports of the country.

Romance of Marine Salvage

THERE is something very appealing about the work of marine wrecking companies as we call them, or marine salvage companies as they are known on the other side of the water; so much so, indeed, that the stories which we have published from time to time of the operations of our own wrecking companies have always been welcomed and appreciated. The exigencies of the war, and particularly the submarine campaign, made a big demand upon the salvage companies to which they responded in right royal fashion, and the Liverpool Salvage Association has made a report which shows how positively amazing were both the activity and the successes of the salvage operations of the war. Thus, we learn that during the ill-fated Dardanelles expedition, of fifty-one vessels sunk near the beaches all were speedily reclaimed by the wrecking outfit of the association. Within a period of ten days in the month of June, 1917, four steamers, with a total deadweight of 30,000 tons, which had been torpedoed and sunk in the English Channel were brought into port. It will be remembered that the "Lion" was badly holed by gunfire during the running fight known as the Dogger Bank action, and it was one of the company's vessels, the "Ranger," which brought the ship in. This she did by building a cofferdam of timber backed by cement around the smashed armor plate, and putting the ship into a sufficiently watertight condition to get home. Another notable rescue was that of the "Britannia," a pre-dreadnaught battleship, which had torn open her bottom by stranding on the rocks of the Scottish coast. The hospital ship, "Asturias," which had been torpedoed, was saved by the salvage craft pumping out water from the ship at the rate of 12,000 tons an hour. It was the same vessel, "Ranger," that brought up "K-13," sister ship to the submarine recently lost during maneuvers, to the surface from a depth of 62 feet, and so rescued the crew after two and a half days' entombment on the sea bottom. So this one vessel steamed from one disabled vessel to another until she had covered in all 17,000 miles; and, not content with that war record, she did good work after the armistice in raising wrecked British ships that had been sunk in the attacks at Zeebrugge.

That such wonderful results can be accomplished is due to the fact that marine salvage is a highly developed art, requiring special plant and a wide practical experience. If you asked a wrecking expert what were his most helpful applances, he would mention, doubtless, compressed air, the centrifugal pump and the free use of timber, planking, and concrete; but he would also tell you there is no cut-and-dried system that can be given general application. In other words, every wrecked ship is a problem in itself. Inventive skill may find methods superior to these, but for the present they control the situation.

Industrial Efficiency

Industrial Housing. — Among the latest advances in industrial housing are two model towns which have been erected by employees of the rubber industry at Akron, Ohio, known as Firestone Park and Goodyear Heights, the latter of which now has 18 miles of paved streets and is complete with shops, public buildings, and welfare institutes.

Prison Education. — A movement is on foot at Calgary, Alberta, for the establishment of a system in the different prisons of Canada to give some sort of business education to the inmates. A dispatch from London, England, to the effect that a movement is being started there to give men in Wandsworth jail a business education has given impetus to the endeavor. It is claimed that a number of prisoners lacked the facilities in youth to acquire education to make a living, have records of good behavior, and if they could be given some training while in jail would be better fitted to take their part in the world's work upon being released.

From Firearms to Automobiles. — The works of an Austrian arms manufacturing company in the city of Stepyr, Upper Austria, are now manufacturing high grade six-cylinder passenger automobiles and trucks by a new method. The end of the war found them with an equipment capable of producing 1,000,000 rifles and other small arms per year. Now they are making a few sporting rifles of the "Mannlicher" model and shotguns. During the war the works employed about 15,000 men; they now have about 6,000. Thus far the company has produced about 400 automobiles; it expects to produce 4,000 in 1921 and 10,000 in 1922, and to increase after that to 20,000 machines per year. It is said that the automobiles are in great demand, and are now sold in England, France, the Netherlands, Germany, Poland and Rumania.

Germany's Artificial Wool is prepared by a process which consists of compressing wool scraps which could not otherwise be utilized—shreds, ends, short fibers, washing wastes, etc., after treating them with certain chemical solutions. An investigation of the process develops the fact that experiments to that end were conducted personally by Herr Paul Krais, director of the chemico-physical section of the German Research Institute for the Textile Industry, at Dresden. Herr Krais is authority for the statement that the results of his experiments were unsuccessful, and that the application for a patent for this process has been abandoned. It appears that it is impossible to put the wool into solution without a resultant decomposition. In his experiments Herr Krais subjected to heavy pressure through tubes damp wool under high temperature, but the resultant threads did not possess the necessary tensile strength.

Reclaiming Waste and Wipers. — The wash and reclaiming equipment developed by a leading American laundry machinery company, makes it possible to reclaim waste some 10 to 15 times, and wipers some 20 to 30 times. The waste and wipers are first placed in a washer consisting of a horizontal rotating perforated cylinder mounted concentrically with a stationary cylinder. The washer is motor driven, and the interior is supplied with hot and cold water and live steam. Several changes of water are necessary, and the cleansing operation takes from 3/4 to 1½ hours. The drier consists of a centrifugal chamber in which the material is whirled for eight to ten minutes. This process extracts 90 to 95 per cent of the moisture, and the waste is then ready for drying. The drying machine is asbestos lined, and the air passing through it is first heated over steam coils and then forced by a fan through the waste. It is said that the reclaimed waste is as soft and as absorbent as when new.

Peat as Railroad Fuel. — Tests extending over several months have passed the experimental stage and conclusively demonstrated that peat, reduced to powder or prepared in the form of briquets, makes an excellent substitute for coal as fuel for locomotives. The Railway Board of Sweden, satisfied with the results of these long-continued tests on the State railroads, has recently taken over the specially constructed plant at a bog near Vislanda, with a capacity of 30,000 tons per annum. The machinery employed is well adapted for the purpose of converting peat into a cheap and effective fuel with a minimum working force. The peat is dried in the open air as far as possible. Only the hardest and driest lumps are used for ordinary fuel, the remainder being converted into powder or briquets. The plant was originally intended for the manufacture of peat powder, but it was found that briquets were as well adapted for fuel, hence both are now being made. The discovery was also made that powdered peat becomes a dangerous explosive when subjected to high temperature.

Science

A New Type of "Boll Weevil" has turned up. This is a date scale which must be eradicated or the entire date industry of the United States will be wiped out in two or three years.

A Livingstone-Stanley Memorial.— The tree where Stanley met the great English missionary-explorer on November 3, 1871, at Ujiji, in what was formerly German East Africa, is now marked by a stone inscribed "Livingstone-Stanley—1871." It affords a convenient resting place for the irreverent natives.

Overalls vs. Paperalls.—England is being supplied with apparently good blue overalls. Everything seems all right until the laundry is called in to rejuvenate the garment, then it is found that Germany has been up to her old tricks and the fatal bath leaves only the buttons and the linen pockets, for all the rest is paper cleverly masquerading as blue jeans.

Fields To Be "Classrooms."—Application has been made for a charter for a Pan-Pacific university where the "classrooms" will be the sugar and pineapple fields throughout the Hawaiian Islands. Work will begin in the labor camps of all the islands of the group. The instructors will be sent to the students, instead of waiting for the students to come to them. Similar work has been carried on in Porto Rico, with great advantage to the island, the agricultural experiment station and school being located at Mayaguez.

The Dangers of Occultism.—A Psychical Research Society composed of eminent professors and those interested in the scientific aspect of the subject has been formed in Glasgow. The founders caution those of untrained minds that is not a science to dabble in and nothing of a sensational nature will be published or tolerated. Prof. Latta emphasizes the danger of occultism to people who are incapable of making sharp distinctions, as they might jump to alarming conclusions which would result in a neurasthenic condition of mind.

Recent Egyptian Find.—Thousands of mummified bodies of the sacred ibis have been found by the French savant, M. Lacau, in the underground necropolis of the famous ruined temple at Deir Medineh, Egypt. Each bird was in an elaborately decorated vase of earthenware embedded in a sort of cardboard formed by a conglomeration of papyri which totaled hundreds of thousands of written documents. M. Lacau says the find was one of the most important of the late discoveries in Egyptology. The work of deciphering the documents will take years.

Age of the World.—The Abbe Theodore Moreaux, Director of Observatory at Bourges, has recently given some estimates of the age of the earth and when the phenomenon of life appeared on it. He considers 500,000,000 years about right for the age of the earth and he thinks that the temperature dropped to a point where life could exist about 250,000,000 years ago. Man was a comparative newcomer and the Abbe gives only some tens of thousands of years, thus refuting an estimate of a German scientist, who recently gave 400,000 years as the probable period for the advent of man.

A "Weedless Lawn."—A long-sought fertilizer has at last been secured after twenty years of research, which will slowly and surely extirpate the weeds, while permitting the grass to grow freely. Ammonium sulfate is found to be more advantageous than sodium nitrate, which tends to create an alkaline condition of the soil, especially favorable to the propagation of weeds. Ammonium sulfate produces reversed conditions and the grass flourishes and the weeds are so weakened that they are crowded out. Of course this plan of fertilization must be qualified, as only grass that is an acid tolerant would develop along the line of extirpation of the weeds. The weeds to resist must be non-acid tolerant also.

Papal Land Reclamation.—The Papal authorities are trying to induce capital to invest in a reclamation scheme for the irrigation and consequent reclamation of the Pontine marshes. The chief town in the area is Ostia, which in 50 B. C. was one of the principal cities of Italy, but in the first century A. D., deposits from the Tiber silted up the harbor and ruined the city. Then came malaria which rendered the whole tract very unhealthy. The idea is to build another city near Ostia to relieve the housing situation in Rome, the distance would be only about nineteen to twenty miles. This would give Rome a maritime port which she needs badly. The engineering charges would be borne in connection with the reclamation work of the Pontine marshes. About $50,000,000 would be required for the reclamation work. The acreage which would be salved is very large, but the cabled reports as to the exact quantity of land involved is misleading.

Automobile

The Automobile Industry.—The automobile business is the largest manufacturing business of finished goods in the world, says *Machinery*, in a recent issue. This year the total volume of the automobile, accessory and supply business in this country alone will reach $4,400,000,000, of which over $2,000,000,000 will represent passenger cars and trucks. There is one car in use for approximately every 13 persons in the United States, as compared with one for every 2,182 persons in the rest of the world—268 in England, 402 in France, 684 in Germany, and 5,300 in Russia. Europe has 449,000,000 people and only 437,000 automobiles. It is estimated than 45 per cent of the automobiles sold in this country are bought by farmers and the inhabitants of small towns. The average life of a car is estimated at five years. There are about 800,000 trucks in operation in the United States, hauling an average of 4½ tons per day each, which amounts to a total of 3,600,000 tons per day, or 360,000,000 tons per year. Figures show that the average ton-mile cost of motor truck haulage is 18 cents, as against 0.96 cent by railroad locomotive; but the railroad terminal charges are large, and time is saved by the motor truck. Haulage by horse is estimated to cost 24 cents per ton-mile, and it is said that truck haulage has released 3,600,000 horses for various other purposes in the United States. The automobile accessory and supply business, including tires, gasoline and oil, has reached a volume greater than that of the automobile business itself.

Spark Plug Location Important.—Many cases of ignition trouble have been traced to the use of improper spark plugs or to faulty location of these members. Manufacturers of spark plugs have given the matter of location considerable thought during recent years, and the endeavor is to produce a plug specially designed or adapted for the motor for which it is to be used. The spark plug shell or base is constructed so the spark points will project into the combustion chamber. It is also important to make provision for proper cooling of the spark plug. This last named factor is an important one that is seldom given consideration by owners or repairmen who change the spark plugs without making sure that they are adapted to the motor. To obtain the greatest efficiency from the explosion it is important that the spark points project into the combusion chamber in such a way that they be surrounded with cool fresh gas. If the gap of the plug is located in a recess or pocket, dead gas is apt to accumulate about the points, and combustion will be much slower than it would be with the spark plug, so the spark points project into the intake chamber, permitting the spark to take place in fresh mixture and promote rapid spread of the ignition flame. It will be apparent that with a projection from the plug body having a space around it in which the hot gases may collect, the plug will heat up much quicker than the mounting in which the heat will be conducted away by the cooling water. A plug that becomes heated will tend to soot up and carbonize much quicker than one in which provisions have been made for proper cooling.

Composition of Automobile Exhaust Gases.—A. C. Fieldner, speaking before the Chemical Society of Washington recently, reported an extensive series of investigations made by the Bureau of Mines on the composition of automobile gases in relation to ventilation of vehicular tunnels. This work has demonstrated a number of important conclusions as to the extent of incomplete combustion in automobile engines. An average of about 6.4 per cent carbon monoxide in the exhaust gases from all types of machines tested for all conditions of test is reported. With the proposed vehicle tunnel from Manhattan to New Jersey this represents at the full capacity of the tunnel a discharge of about 400 cubic feet of carbon monoxide per minute, which would require for proper elimination the movement of approximately 1,000,000 cubic feet of air per minute. The percentage of carbon monoxide in the exhaust varies widely with the adjustment of the carburetor and the conditions of driving. The largest percentages of carbon monoxide are formed when accelerating or climbing grades—that is, at the time of greatest power demand. The point of maximum power production from an engine is quite different from the point of maximum thermal efficiency. At the point of maximum power richer mixture is used than corresponds either to the point of maximum thermal efficiency or to the point of theoretical air-gasoline ratio. As a practical matter, the best remedy for gasoline losses caused by inefficient operation is, in the opinion of Dr. Fieldner, to be accomplished only through more extensive use of dash control devices so that the richness of the mixture can be adjusted by the driver according to the power demands.

Reorganizing the Port of New York

Port Commission Plan for Modernizing the Railroad and Shipping Facilities of New York

THE report of the New York-New Jersey Port and Harbor Development Commission recently made public deals with this vast and complicated subject in a most comprehensive way, and were it not for the fact that it proposes the expenditure of 200 million dollars upon a tunnel system of limited capacity, we should feel prepared to give the report our unqualified endorsement. This phase of the subject is discussed at some length on our editorial page.

The report contains three major proposals: first, the creation by agreement between the two States of a Port Authority with jurisdiction over the entire Port District, so constituted as to enable it to carry out a continuous policy; second, the construction of three belt lines of standard railroad, to be known as the Outer, Middle and Inner or Waterfront Belt Lines; and third, the construction of an electrically-operated system of tunnels connecting a transfer yard in the Jersey meadows with a tunnel belt line beneath Manhattan Island, to be used exclusively for the transportation of food and general merchandise. The first two of these proposals should receive unqualified endorsement; the tunnel proposal should be rejected on the ground that its scope is too limited, inasmuch as it deals with a portion only of the freight traffic and makes no provision whatever for long-distance express and local passenger traffic, nor for continuous trolley service, nor for the enormous and ever-growing automobile and motor truck traffic between New York and New Jersey.

The Three Railroad Belt Lines

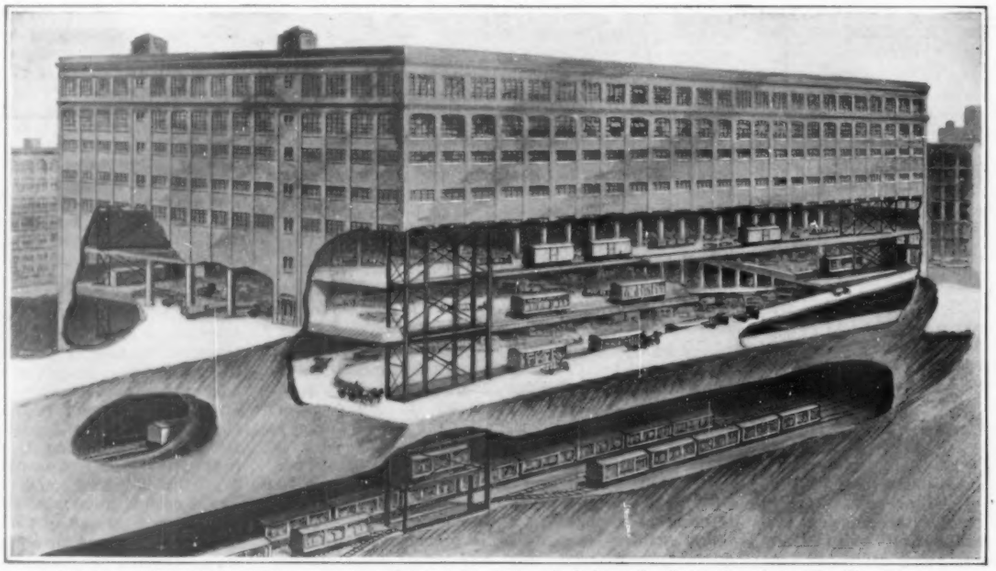
In order to secure a perfect distribution of incoming and outgoing railroad freight and enable a car coming in over any particular road to be hauled direct to any point on the waterfront of New York, the Commission recommends the building of the three belt lines which are shown on the front page of this issue. The outer belt line starts from the Hudson River at Piermont, about twenty-five miles north of the Battery; makes a broad sweep through the country lying back of Jersey City at a distance of from ten to fifteen miles from the North River waterfront; crosses to Staten Island and swings round to a connection with a waterfront railroad belt line which extends along the easterly shoreline of that island. It is proposed ultimately to run a branch from this outer belt, leaving it near Springfield, New Jersey, and running easterly to a tunnel which will extend from the Jersey shore to the Long Island shore, there to connect with the Middle Belt Line. This Middle Belt Line will utilize the existing Long Island Railroad and the New York connecting railroad, thereby giving an extension by way of Hellgate Bridge through the Bronx to the New York Central tracks at Spuyten Duyvil.

Coöperating with the Outer and Middle Belt Lines as above described will be a system of inner or waterfront belt lines, one extending from the Outer Belt Line south through Perth Amboy and along the Raritan River, another serving the westerly and easterly waterfront of Staten Island. Moreover, there will be other sections encircling Jamaica Bay, Flushing Bay, and the southerly shore of the Bronx, and there will be three separate sections serving the Brooklyn waterfront along the East River and the upper bay. All of these sections of the waterfront belt system will, of course, have direct connection with existing lines. In Jersey City, furthermore, there will be a belt running along the waterfront from Fort Lee to Bayonne, a second inner belt extending from Leonia on a course generally parallel and two miles to the west of the Jersey City waterfront, and a third inner belt extending from the neighborhood of Ridgefield Park, in a southerly direction to Elizabethport.

Heavy Railroad Freight Traffic

Twelve railroads reach the Port of New York. Nine of these terminate in New Jersey or Staten Island, and three of them enter from New York State and terminate in Manhattan. Of the 76,052,000 tons of freight moved into, out of, or through the Port District in 1914 by the railroads, 53,359,000 tons were brought in by rail. Of these 53,359,000 tons of freight, 34,345,000 tons consisted of fuel and ore. Also, there were 4,000,000 tons of grain and mill products, another 4,000,000 tons of other foodstuffs, and yet another 4,000,000 tons of building materials. The remaining 6,747,000 tons were classed as miscellaneous. Practically all of the fuel and ore tonnage was distributed locally by lighter; about 50 per cent of the miscellaneous freight was handled by car-float, and 40 per cent of the foodstuffs other than grain was also handled by car-float.

Under existing conditions, the various railroads run to their own freight terminals at the waterfront, and there is practically no means by which freight cars coming in by one railroad can readily be transferred by rail to any other railroad for transport to its destination. The construction of these belt lines will solve that problem, at a stroke, by rendering our whole railroad system at the Port of New York thoroughly fluid or elastic.



At the tunnel level is an eight-car, crewless, electric train, just arrived from the Jersey transfer yard. The cars are raised, one at a time, by elevator to the desired floor of the terminal warehouse. Here the small 3′ by 6′ trailer cars, containing the merchandise, are wheeled out of the electric cars for distribution of their contents in the warehouse or to motor trucks

Typical automatic-electric terminal of the proposed freight tunnel

Automatic Electric Tunnel System

The essential elements of this system which is designed for meeting the food and general merchandise, or less-than-carload lot, traffic (shown in dotted white lines on our birdseye view) are: (1) a belt line railroad in New Jersey reaching all of the New Jersey railroads that give pier-station service; (2) a joint yard and transfer station on this belt line; (3) two parallel standard-gage tracks running in a loop in separate tunnels from the New Jersey yard to Manhattan and back; (4) a series of multiple-story freight terminals above the loop in Manhattan, with car elevators from the deep tunnel to the street surface; (5) a separate connection and transfer station in Manhattan for the New York Central Railroad; (6) a fleet of special electrically-operated cars with a fleet of small four-wheel trailer trucks.

At the transfer yard of this electric tunnel system in New Jersey, there will be twenty-four long parallel platforms, each with a standard railway track on one side and an automatic electric track on the other side. The freight will be unloaded from the standard railroad car into small trailers, which measure three feet by six feet, and the trailers will be hauled along the platform and loaded side by side into the automatic electrical cars, each of which will hold twelve trailers and will be somewhat larger than the ordinary box car. These cars will be made up into trains of eight, which will be operated electrically and automatically, and will run at an average speed of 13.2 miles per hour through a tunnel below the Hudson River which will emerge in the neighborhood of 47th Street, Manhattan. This tunnel will be built at a depth of about 80 feet below street surface, so as to avoid interference with future extensions of our subway system. The tunnel will extend southerly below Manhattan Island from 47th Street to the Battery, and at intervals there will be located above it at street level, large storage and distributing warehouses. The cars, each with its load of twelve trailers, will be raised one at a time by an electric elevator to the warehouse level, where the 3 ft. by 6 ft. trailers will be run out to the platforms. The empty cars will be moved forward to the other end of the building where they will be lowered by elevator to the tunnel level, and returned to the New Jersey distributing yard by way of a tunnel below the Hudson River at the Battery. There will be no train crews, the movement of the trains being entirely controlled at a central dispatcher's office.

Such, in brief outline, is the system by which the Commission proposes to handle the distribution of foodstuff and light merchandise. It is estimated that the total cost of this system, which will serve Manhattan from Central Park to the Battery, will be slightly over 200 million dollars. The rectangular loop shown on our map embracing Central Park and extending to Harlem, with a distribution yard located on Ward and Randall's Island, *is not included in the present scheme*, but will be constructed when the present plan has proved itself in practical operation. The cost of the upper loop, together with its Hudson River tunnels, distributing yard, et cetera., will probably be about equal to the cost of the first system, or approximately $200,000,000, making a total of $400,000,000.

Kind of Traffic To Be Handled

It is the opinion of the Commission that virtually all the traffic now handled at the railroad pier stations and at the freight houses of the floatbridge terminals can be handled economically by this system. The heavy freight of the float-bridge terminals cannot be accommodated in the proposed tunnels and these terminals, it is considered, should be retained. The St. John's Park terminal of the New York Central and the New York Central tracks in Tenth and Eleventh Avenues would be removed. The new system would be able to handle the milk supply and other perishable food; it would be well adapted to the handling of express packages, and it is believed that because of the absence of delays, and the expeditious and well-organized delivery at the twelve warehouses in Manhattan, the food will be received in New York in a far more fresh and wholesome condition than under the existing methods.

An Excellent Plan, but Too Limited

There can be no doubt that if this new automatic tunnel system develops no unforeseen defects, it will be an admirable method of handling that part of the traffic at this port which is included under the general description of less-than-carload lots, such as food

(*Continued on page 235*)

Better Railway Ticket Selling

By Ralph Howard

EVERYBODY remembers the old-fashioned ticket racks in the railroad station, which held through tickets stretched out at full length; and everybody has seen the agent drag forth the desired form from one of these racks, much as a protesting earthworm of gigantic proportions might be dragged, unwillingly, from its hole. But this sort of thing is now of the past, and with it the necessity of the ticket agent's walking the length of a large room in search of a through ticket to Salina, Kan., via Lackawanna, Wabash and Rock Island, or some other cruel and unusual combination of routes which the itinerary of the would-be passenger might call for. The New York Central has had in operation for a sufficiently long time to demonstrate its success, a brand new system, based upon the "portable ticket case." By this system, according to its present sponsors, a passenger may be accommodated with any kind of ticket—railroad, through or local, Pullman sleeper or parlor car, to any point—at one window. It involves combining in one compact cabinet—three feet nine inches wide, two feet deep and seven feet high—any and all tickets a traveler may need. In it the long through tickets are folded for the first time, instead of hanging on hooks at a lengthy general case used by all sellers, which meant extra steps for all clerks.

Every ticket—over 3,000 forms in all—is at the seller's elbow. Where the clerk used to walk 10 to 100 feet, while the buyer fumed, the ticket is now within reach. A statistical sharp figured that—with 30 feet the average round-trip of a clerk for a long-distance ticket form in the forty largest city terminals—the elimination of this trip will save, together with the passenger's journey to another ticket window, several hundred thousand steps each working day.

This new ticket case, tested and now used at Grand Central Terminal, New York, has greatly relieved congestion at three ticket windows, and the long queues of impatient waiters often seen at depots.

The new system has so increased capacity and efficiency that the building of additional windows—at a cost of a quarter of a million dollars and sacrifice of architectural beauty—has been rendered unnecessary at Grand Central, and the public is receiving an unprecedented service.

The new ticket case permits a flexible system by which capacity may be expanded instantly, to care for the rare "peak load" of travel. Each case is a complete rolling ticket office and, if demanded, a score can be placed in the open concourse to take care of football or holiday crowds.

The New York Central has thirteen ticket windows at Grand Central Terminal—five through or interline, five local, and three Pullman. Formerly three clerks joined in using Pullman and through railroad ticket cabinets, involving a walk from the buyer to case and return of as much as forty feet. Now each clerk has his own case containing every kind of ticket at his elbow; he need never leave his customer, and his steps and the traveler's patience are conserved.

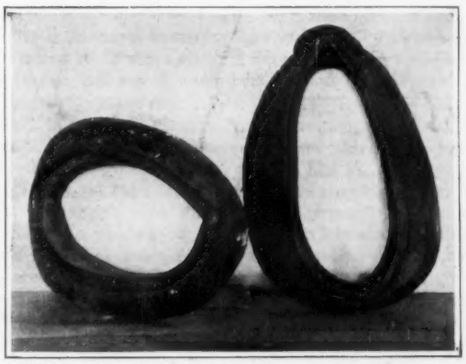
Formerly when ticket clerks changed, the window was closed and the station put out of service, while the accounts were audited. The new case makes this unnecessary, the result being that each window is available for use 100 per cent of the time, greatly increasing the capacity of the office.

The New York Central's lead in this improvement already is being followed, and the portable case system has been approved for installation in the Union Station at Washington, D. C., at Pennsylvania Station, New York City, and other large centers.

The compact portable ticket case that takes the place of the inconvenient racks of long familiarity

Rats and Canvas

IN the eternal struggle against the depredations of pack rats and other rodents, the Mount Rose Observatory has found where tin or close-meshed wire netting is not easily available, that heavy canvas bags are the most feasible receptacles for bedding and any material whose smell is not pungently attractive. On only two occasions in fifteen years have rodents gnawed through canvas. Other fabrics, however, are no barrier and paraffin proofing is a positive attraction. Washing powders are no deterrent to consuming the paraffin cartons in which they are placed.



This horse-collar has a capacity of several quarts of illicit "hootch"

Outwitting the French Customs

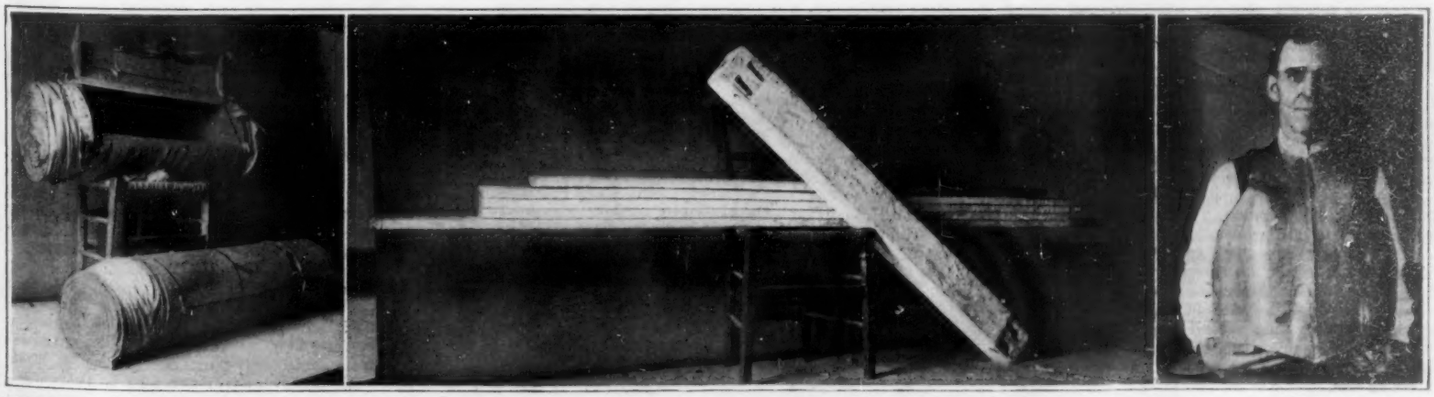
By George F. Paul

WAR has evidently sharpened the wits of the Frenchman in and around Paris who make a practice of bringing produce of various kinds through the city gates. For years it has been the custom to have men stationed at the different gates to collect the taxes imposed on certain products brought into the city. These officials sometimes grow a trifle lax in their inspection, especially when the driver of the wagon or truck is an old friend that they trust. As the war progressed and as the price of necessities, especially oil and wine, steadily rose in Paris, some of the drivers began to scratch their heads and wonder if they couldn't devise some innocent-looking receptacles that they might take through the city gates every day right under the very eyes of the inspectors and yet not be caught in the act of smuggling taxable goods.

Accordingly they began to exercise all of their inventive genius and presently they had evolved many queer receptacles that varied in capacity from a few quarts to several gallons. The men at the octroi-stations were deceived for several weeks by the boldest of these men. He was always very cordial with the officials and sought to win their good will by giving them tobacco and other presents from time to time. Presently rumors reached them that he was smuggling oil into the city every day. This put them on the alert, with the result that the following day when he appeared as usual with his innocent-looking load of lumber, they began to tear it all apart. In vain did he protest that he was late even then and that he simply had to hurry on. This only made them the more determined to go through his whole load. Presently they came to five boards that were nailed together in a manner that aroused their suspicions and on examining them closely they found that the top board simply covered an opening through which a tin receptacle nearly five feet long could be passed to the snug place of concealment hollowed out for it. The driver, who had been very indignant and blustering up to this point, became very meek and penitent when several gallons of smuggled oil were confiscated. While this examination was in progress, one of the police noticed that the horses wore remarkably large and peculiar collars. He ordered the driver to remove the collars from the horses' necks and when this was done it was discovered that the collars were hollow and so fitted up that they could hold oil. Needless to say, the career of this particular man as a smuggler ended that day.

This experience seemed to arouse the inspectors at all of the city gates. They almost turned wagons and carts upside down in their efforts to detect any smuggling. One of their first hauls was a magnificent funeral wreath that seemed uncommonly heavy. When some of the flowers were removed and a tap unscrewed, three jugs were filled with the wine that was being smuggled through. Some abnormally large cabbage heads were examined closely; each contained nearly a quart of wine in a flat flask hidden in the heart of the cabbage. Rolls of cloth also aroused the suspicions of the inspectors. These rolls were found to have genuine cloth at the ends so as to present the proper appearance, but in the middle was a handy receptacle capable of containing several bottles of wine or oil.

Even the cushions on which the drivers sat were pressed into the smuggling service. Of course they were made hollow and filled with flat tanks that were not comfortable, but the drivers did not care, so long as these cushions proved money-makers.



Left: Carefully prepared rolls of cloth or carpet that contain smuggled goods, solid or liquid. *Center:* Boards nailed together may conceal a tank of considerable capacity. *Right:* Breastplate covering for the smuggler, under which he can carry goods that would give him away if their contour were exposed

Some of the dodges of the French smugglers entering the city of Paris

From the Einstein Contest—IV

The Principle of Relativity—A Statement of What It Is All About, in Ideas of One Syllable

By "Shinglewood" (Hugh Elliot, Chislehurst, Kent, England)

THE invariance of the laws of nature was one of the most popular themes of nineteenth century philosophy. For it was not till last century that general acceptance was accorded to the doctrine of the "Uniformity of Law," adumbrated in ancient times by Epicurus and Lucretius. It is now a cardinal axiom of science that the same cause in the same conditions is always followed by the same effect. There exists in nature no indeterminate element; all things are governed by fixed laws, and the discovery of these laws is the main business of science.

[It is necessary to guard against reading into this statement an erroneous idea of the content of a "law of nature." Such a law is of course not an enactment of any sort; and it is not even to be thought of as an actual explanation of the how and why of the phenomena with which it has to do. It really is nothing but an expression of our belief in the pronouncement of the preceding paragraph, that like conditions do produce like results. It is a prediction based on past experience, and is of value merely in that past experience leads us to credit its accuracy. The composite essay by nine contestants and the Einstein Editor, which appeared in the SCIENTIFIC AMERICAN *for March 5th, discusses this question of the reality of natural laws, and should be consulted in connection with the present contribution.]*

This great philosophic principle was derived of course from the study of natural science: *i.e.*, from observations and experiments conducted upon the *earth*. Their comprehensiveness is therefore limited by the fact that the observer is always in a state of rest, or nearly so, as compared with the earth. All observers upon the earth are moving through space at the same velocity; and it was possible to argue that the uniformity of law might only hold good, when experiments were conducted at this velocity. An observer moving at very different velocity might discover that the laws of nature under these new conditions were somewhat different.

Such a view could indeed never be very plausible, for motion is only a relative conception. Imagine a universe consisting of infinite "empty" space, in which there is poised a single material body. How shall we determine whether this body is at rest, or whether it is moving at high or low velocity through space? It is never getting nearer to anything or farther from anything, since there is no other body for it to get nearer to or farther from. If we say it is moving at a uniform velocity of a thousand miles a second, our statement really has no significance. We have no more reason for affirming that it is in motion than we have for affirming that it is at rest. In short, there is no such thing as absolute motion: the conception of motion only arises when there are two or more bodies changing their position relatively to one another. This is what is meant by the relativity of motion. It seemed therefore improbable that the laws of nature would be different if the observer were moving at high velocity; for the movement of the observer is not an absolute quantity, but merely a statement of his relation to other bodies, and if there *were* no other bodies, the statement itself would be meaningless.

Now among the established laws of nature is that which specifies the velocity of light moving through a vacuum. If the laws of nature are invariable, this velocity will always be the same. But consider what would happen under the following circumstances: Suppose that we are at rest, and that an observer on another body flies past us at 150,000 miles a second. Suppose that at the moment he passes, a piece of flint projecting from him grazes a piece of steel projecting from us, giving rise to a spark; and that we both thereupon set about to measure the velocity of the light so produced. After one second, we should find that the light had traveled about 186,000 miles away, and since during this second the other observer had traveled 150,000 miles, we should infer that the light traveling in his direction was only about 36,000 miles ahead of him. We should also infer that he would find this out by his experiment, and that he would estimate the velocity of light as only 36,000 miles a second in his own direction, and 336,000 miles a second in the opposite direction. But if this is so, then that law of nature which specifies the velocity of light is quite different for him and for us: the laws of nature must be dependent upon the observer's motion—a conclusion which appears incompatible with the idea of the relativity of motion.

And it so happens that it is also contradictory to experimental conclusions. Experiments undertaken to settle the point show that each observer finds the same velocity for the light of the spark; and after one second, each observer finds that the light has traveled 186,000 miles from himself. But how is it possible that when it has traveled 186,000 miles in the same direction as the other observer who himself has moved 150,000 miles meanwhile, he should still think it 186,000 miles ahead of him? That is the initial paradox; and since there has been no room for error in the experiments, we are forced to conclude that there was something wrong in the assumptions and preconceptions with which we started.

There can in fact be only one interpretation. If we each find that the light has moved the same number of miles in the same number of seconds, then we must be meaning something different when we speak of miles and seconds. We are speaking in different languages. Some subsidence has occurred in the foundations of our systems of measurement. We are each referring to one and the same objective fact; but since we describe it quite differently, and at first sight incompatibly, some profound alteration must have occurred in our perceptions—all unsuspected by ourselves. It has been shown precisely what this alteration is. A body moving at high velocity must become flattened in the direction of its motion; all its measuring apparatus, when turned in that direction, is shortened, so that no hint of the flattening can be obtained from it. Furthermore, the standards of time are lengthened out, and clocks go slower. The extent of this alteration in standards of space and time is stated in the equations of the so-called Lorentz transformation.

THE essay by "Shinglewood," presented herewith, is probably the second-best produced by the Einstein contest. It was the last one eliminated by the Judges, being the only one that seemed adequate to accompany the winning essay of Mr. Bolton in taking precedence over that of Dr. Murnaghan, which appears in the current SCIENTIFIC AMERICAN MONTHLY*; and it is certainly third to no other essay than Dr. Murnaghan's. It will be seen to be distinctly more elementary in tone than Mr. Bolton's. Indeed, had it not been for Mr. Elliot's unfortunate concluding paragraph which we have suppressed, his uncertainty on the fundamental character of a natural law on which we have commented, and his tendency by way of emphasis to say the same thing in too many different ways, his greater simplicity of outline might have carried him through. In any event, his essay is emphatically a contribution to the popular literature of relativity.*—THE EINSTEIN EDITOR.

We are accustomed to describe space as being of three dimensions, and time as being of one dimension. As a matter of fact, both space and time are "ideas," and not immediate sense-perceptions. We perceive matter; we then *infer* a universal continuum filled by it, which we call space. If we had no knowledge of matter, we should have no conception of space. Similarly in the case of time: we *perceive* one event following another, and we then invent a continuum which we call time, as an abstraction based on the sequence of events. We do not see space, and we do not see time. They are not real things, in the sense that matter is real, and that events are real. They are products of imagination: useful enough in common life, but misleading when we try to look on the universe as a whole, free from the artificial divisions and landmarks which we introduce into it for practical convenience. Hence it is perhaps not so surprising after all that in certain highly transcendental investigations, these artificial divisions should cease to be a convenience, and become a hindrance.

Take for instance our conception of time. It differs from our conception of space in that it has only one dimension. In space, there is a right and left, an up and down, a before and after. But in time there is only before and after. Why should there be this limitation of the time-factor? Merely because that is the verdict of all our human experience. But is our human experience based on a sufficiently broad foundation to enable us to say that, under all conditions and in all parts of the universe, there can be only one time-direction? May not our belief in the uniformity of time be due to the uniformity of the motion of all observers on the earth? Such in fact is the postulate of relativity. We now believe that, at velocities very different from our own, the standard of time would also be different from ours. From our point of view, that different standard of time would not be confined to the single direction fore and aft, as we know it, but would also have in it an element of what we might call right and left. True, it would still be of only one dimension, but its direction would differ from the direction of our time. It would still run like a thread through the universe, but not in the direction which we call straight forward. It would have a slant in it, and the angle of the slant depends upon the velocity of motion. It does not follow that because we are all traveling in the same direction down the stream of time, therefore that stream can only flow in the direction which we know. "Before" and "after" are expressions which, like right and left, depend upon our personal situation. If we were differently situated, if to be precise we were moving at very high velocity, we should, so to speak, be facing in a new direction and "before" and "after" would imply a different direction of progress from that with which we are now familiar.

But, after all, the objective universe is the same old universe however fast we are moving about in it, and whatever way we are facing. These details merely determine the way we divide it up into space and time. The universe is not affected by any arbitrary lines which we draw through it for our personal convenience. For practical purposes, we ascribe to it four dimensions, three in space and one in time. Clearly if the time direction is altered, all dimensions both of space and time must have different readings. If, for instance, the time direction slopes away to the left, as compared with ours, then space measurements to right and left must be correspondingly altered. An analogy will simplify the matter.

Suppose we desire to reach a point ten miles off in a roughly northeasterly direction. We might do so by walking six miles due east and then eight miles due north. We should then be precisely ten miles from where we started. But suppose our compass was out of order, so that its north pole pointed somewhat to the west of north. Then in order to get to our destination, we might have to walk seven miles in the direction which we thought was east, and a little more than seven miles in the direction which we thought was north. We should then reach the same point as before. Both observers have walked according to their lights, first due east and then due north, and both have reached the same point: the one observer is certain that the finishing point is six miles east of the starting-point, while the other is sure it was seven miles.

Now we on the earth are all using a compass which points in the same direction as regards time. But other observers, on bodies moving with very different velocity, have a compass in which the time-direction is displaced as compared with ours. Hence our judgments of distances will not be alike. In our analogy, the northerly direction corresponds to time, and the easterly direction to space; and so long as we use the same compass we do not differ in our measurements of distances. But for anyone who has a different notion of the time-direction, not only time intervals but space distances will be judged differently.

In short, the universe is regarded as a space-time continuum of four dimensions. A "point" in space-time is called an "event"—that which occurs at a specified moment and at a specified place. The distance between two points in space-time is called their "interval." All observers will agree as to the magnitude of any interval, since it is a property of the ob-

(*Continued on page 235*)

The Balky Motor

Some of the Things to Look for When the Automobile Refuses to Do Its Duty

By Victor W. Pagé, M.S.A.E.

THERE is nothing more annoying to the average automobile owner than motor trouble along the road, and while this can be prevented in most cases by careful and systematic inspection before starting on a trip there are certain minor difficulties that are apt to occur no matter how careful the motor is looked over. If a motor refuses to start after operating in the proper manner for a considerable time the difficulty is usually one of minor importance that can be located quickly by a systematic investigation of the various auxiliary parts which are necessary to motor operation. Many motorists immediately start to change the carburetor adjustment when trouble occurs, but this should not be done until the following points have been checked over and it is determined that the carburetor is really at fault. First make sure the gasoline is reaching the carburetor float chamber and that it is pure gasoline and not water and rust that fill that member. Open a drain cock under the spray nozzle, or detach the gasoline coupling at the float chamber to allow any water or sediment that may have collected at those points to drain off. If the engine is not provided with a priming device make sure that gasoline reaches the cylinders by injecting some through a priming cock or the opening obtained by removing the spark plug. Next make sure that a spark occurs by detaching the secondary wire or high tension cable from the spark plug terminal and hold it about one-eighth or one-quarter inch away from some metal part of the motor while it is cranked. Watch for a spark to jump the gap as the motor is turned over, then try the compression of each cylinder by using the emergency hand crank instead of the starter, turning off the ignition switch and opening the throttle wide. A decided resistance to cranking should be felt in each cylinder as the piston reaches its compression point. The next thing to do is to check over the spark timer, to make sure that the spark occurs when the piston in each cylinder has reached the end of its compression stroke and before it starts back on what is normally the power stroke. If the gas reaches the cylinders and the compression is good and the electric spark takes place at the right time there is no reason why the engine should not start easily unless conditions are extremely unfavorable, such as a very cold motor or one with dry pistons.

If the inspection has disclosed that there is gasoline in the float chamber, that the ignition switch is on and the ignition spark occurs at the plug and the motor still refuses to start the following suggestions may be of value: The choker valve does not close. The choker may have been used too much and the cylinders flooded with gasoline in which case the engine must be cranked with the choker and the priming cocks open till gasoline excess is removed. The spark may be timed wrong by having the rotor member in the timer moved around so that it occurs in the cylinder that is not on the compression stroke. One of the valves may fail to close properly or the valve spring may be broken. The exhaust valve may be leaking badly. The valves may be timed wrong—a very rare occurrence. The battery may be weak. The spark plugs may be badly sooted or have too large a gap between the plug points. The gasoline may be of very poor quality. The spark may not be far enough advanced.

If the ignition has been found to be faulty, which condition is determined by ascertaining that no spark occurs at the spark plug gap when the test is made, the following points should be given consideration: the battery may be dead or one cell of the battery may have failed. A test should be made with a metal connection across individual cell terminals. The battery ground connection may be broken. There may be a broken connection or short circuit between the battery and the ignition contact breaker. Test for spark at the breaker point and make sure that the resistance unit on the timer or induction coil is not burned out or broken. There may be a short circuit of the high tension current due to moisture in the distributor block or on the spark plug insulators. The spark plug wires may be arranged wrong. This last is only possible when the wires are practically all of the same length and not carried in a good tubular conduit.

If the motor starts but refuses to keep running the trouble may be caused by: wrong manipulation of the carburetor dash control and failure of the choker valve to return to its open position. Partial obstruction in the fuel supply line which permits the gasoline to feed through but not in sufficiently large quantities to keep the engine running after it has started. Water or dirt in the supply pipe or carburetor. Dirt or water in the vacuum tank outlet. Sticking intake valve. Loose ground connection or poorly made connection at the battery. Loose terminals anywhere on the primary wiring of the ignition circuit. The idling passage in a compound nozzle carburetor may be clogged.

If the motor will start, keeps running but runs irregularly because it misses explosions in certain cylinders at all speeds look for the following defective conditions: Dirty or carbonized spark plugs, cracked spark plug insulator or improperly set gap at the plug points. Short circuited spark plug wires which can be detected by listening for the crackle of a jumping high tension spark or visually by running the engine in the dark. Wires interchanged on two or more spark plugs. Inlet or exhaust valves sticking in guides or held open by lack of proper tappet clearance. Trying to run with the motor very cold or using low-grade gasoline. A leak in the cylinder-head gasket.

If the motor starts and keeps running but operates irregularly at ordinary driving speeds look for: Sooted or cracked spark plugs. Intake or exhaust valves not seating tightly. Gasoline leaking into the intake manifold through the suction connection of the vacuum tank. Air leaking into the mixture

(*Continued on page 237*)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

Early Use of Compressed Air for Salvaging Ships

To the Editor of the SCIENTIFIC AMERICAN:

When practising law in London in 1874 or 5 an engineer about 30 years of age came into my office one day with a personal introduction. He told me that his business with me was to have me prepare for him and his associates contracts for raising several ships and also a great floating dock, all recently sunk in the entrance to the harbor of St. Thomas, in the West Indian Island of that name, in a terrific hurricane. He went on to explain that the floating dock in question had been constructed specially for the repair or reconstruction of Royal Mail steamships, having headquarters at St. Thomas. He said that this dock had been built in Great Britain, had been towed across the Atlantic to St. Thomas, and had been wrecked at the harbor entrance and had blocked the entrance, and that seven ships of varying tonnage, one a new steamship of, I think, 1,500 or 2,000 tonnage, were left there in a tangled mass.

I asked him what agency he proposed to use for so gigantic a task. He answered: "Compressed air led into the holds of the vessel as soon as the divers had made them air and water tight." "How about the dock," I asked. "Of course that is the biggest and hardest job," he said, and went on to explain about as follows: The upper structure of the dock sides had been the chief site of the injury when struck by the hurricane and repairs there would be largely a question of usual outdoor work. The matter of making the floor air and water tight was a serious one, only to be determined after the side walls had been put in working order, since the whole of the lifting power of the dock would be required to raise it to the surface. He was confident that by employing compressed air in large volumes and by the use of trained divers the work could be done.

After due inquiries the money was provided. Then I saw no more of my friend, the engineer, for some months, although I heard from time to time that the work was progressing well. The steamship had been raised, repaired, and sold at a good price. The smaller vessels had also been made sound, raised, and been taken about their business, leaving the floating dock still in the contractors' hands.

I recollect reading in the news of the day that the dock also had been raised; but I knew no details until I came across a foreman who had been employed on the job and had been on the dock when it was brought to the surface, fully repaired, and put in service. He told me that as the dock had to be lifted by its own buoyancy it was necessary that the water should be kept out until the operation was completed. He had been told that in so big a structure it was probable that water would enter in more or less volume and he must be prepared to feel it rising to waist deep before he was let out; he told me that he sat and then stood as the water rose, first waist high, and that did not trouble him; but then it rose to his armpits, and at last to his neck, and he was giving up hope, when outdoor sounds reached him, the lifting ceased, and he was let out of his great cage.

That ends my story. I think—though I am not an engineer—that it is interesting testimony, though forty-six years old, of a big project carried through by the buoyancy from compressed air, as first developed in 1844. WALLIS NASH.

Nashville, Oregon.

Prize for Non-Slip Shoe for Horses

To the Editor of the SCIENTIFIC AMERICAN:

I think many of the inventive geniuses among the vast army of American and Canadian readers of the SCIENTIFIC AMERICAN will be interested to know that a prize of $500 is offered through the American Humane Association of Albany, N. Y., for the most satisfactory horseshoe or device which will prevent horses from slipping on roadways and wherever in service.

Snow and ice increase slipperiness of the pavement. All over the northern part of the United States and in Canada thousands of horses slip and strain themselves. Sometimes they fall and injure themselves; sometimes legs are broken and they have to be shot.

The inhumanity of present conditions is very great. To relieve these conditions and to prevent the distressing suffering of horses, particularly on asphalt and wood block pavements, the above-named association invites the coöperation of all inventors and lovers of man's most useful friend in harness.

The prize will be awarded on July 1st next to the successful inventor or other person who solves the problem. GEORGE FOSTER HOWELL.

New York.

The Gyroscopic Steering Gage

To the Editor of the SCIENTIFIC AMERICAN:

Your readers may be interested to know that the use of the "double-liberty" gyroscope, described so well by Dr. Alfred Gradenwitz in the December 4th issue of the SCIENTIFIC AMERICAN was not confined to German airplanes. I developed independently an instrument based upon the same principle, and called an "airplane turn indicator," for the United States Government. This instrument had been subjected to rigid tests, and was just being put into service when the close of the war stopped its further development. A gyroscopic turn-indicator of similar construction was also being tried out at this time in England.

St. Louis, Mo. ARTHUR H. COMPTON.

Balloons and Air Currents

To the Editor of the SCIENTIFIC AMERICAN:

In the article on air currents in the vicinity of clouds, it seems that a few incorrect inferences have been drawn. First, the effect of heat or cold on the outside of a balloon would not be transmitted to the interior very rapidly, gases being poor conductors. Consequently the displacement of the balloon would not be altered appreciably in a short time. Secondly, the change of specific gravity of the air due to heating and cooling above and below clouds is not great. A barometer placed over a large body of water, where the heat radiation on a hot day is intense, does not show a great fall in pressure.

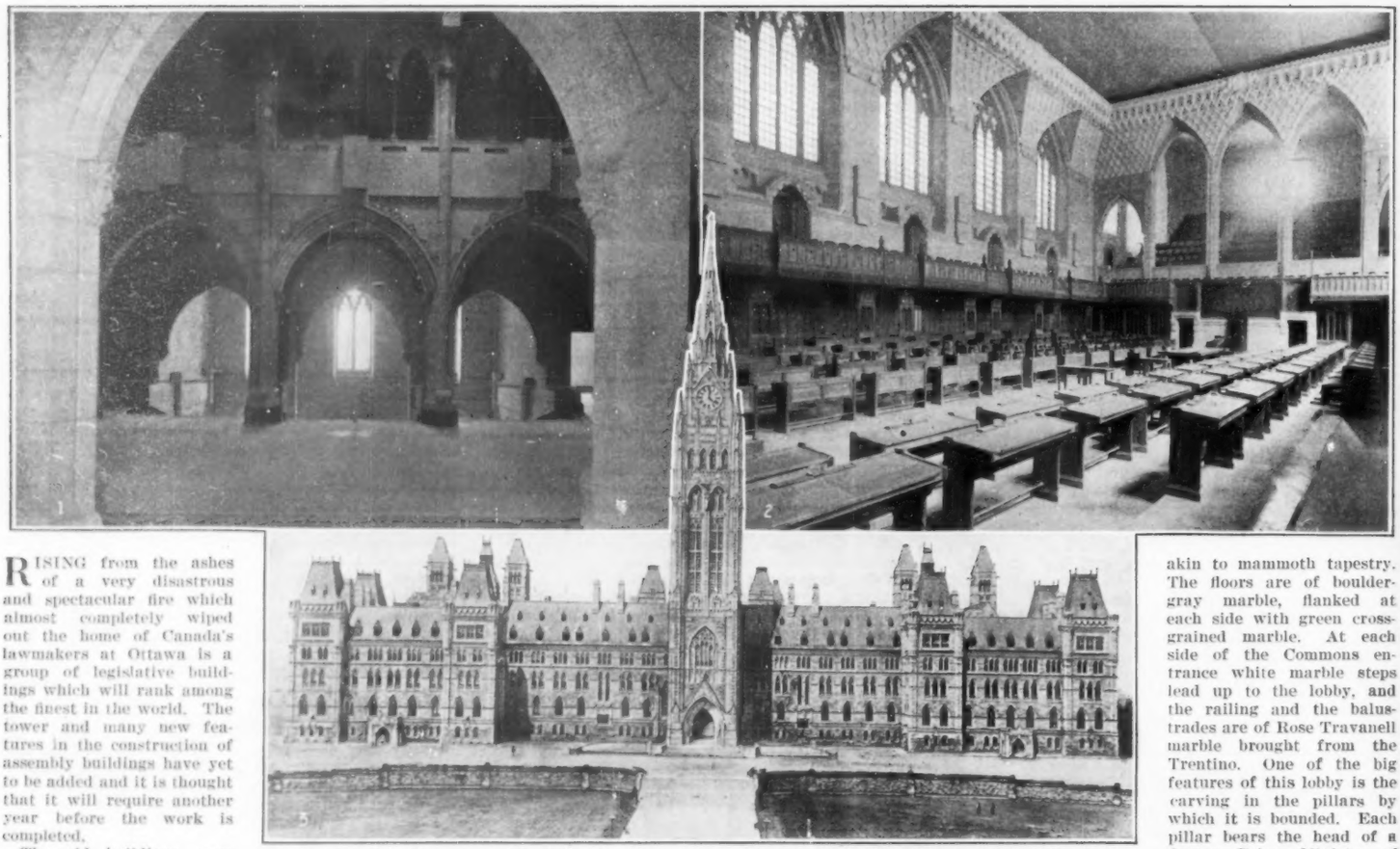
The effects noted in the article are correct, but due to different causes. Below the clouds the air being cooler, moves downward and hence tends to check the rise of a balloon. Above the clouds, the air being warmer, rises and checks the descent of the balloon. The loss of specific gravity which would tend to make the balloon or airplane descend is more than offset by the upward current produced. W. G. LANDON.

Amherst, Mass.

Canada's New Parliament Buildings

Some of the Architectural Features of Ottawa's Legislative Halls, Now Under Construction

By J. H. Armstrong



1. A portion of the Commons corridor, looking from the main door. Gargoyles of Sir Wilfred Laurier and Sir Robert Borden appear at the right and left of the arch. 2. Side view of the legislative chamber of the House of Commons. 3. General view of the entire block as it will appear when finished

The new group that is replacing the Canadian Houses of Parliament destroyed by fire in 1916

RISING from the ashes of a very disastrous and spectacular fire which almost completely wiped out the home of Canada's lawmakers at Ottawa is a group of legislative buildings which will rank among the finest in the world. The tower and many new features in the construction of assembly buildings have yet to be added and it is thought that it will require another year before the work is completed.

The old buildings were destroyed on February 3, 1916, and six people lost their lives. Shortly after resuming the session after dinner, fire was detected in one of the wings and the flames spread with startling rapidity. There was a large attendance of members and the general public, and despite all efforts of those who had knowledge of the occurrence, panic followed the announcement of "fire" and many persons were injured in addition to the number killed or burned to death. Many individual acts of heroism were performed by the members and it was due to their courage and presence of mind that many more lives were not lost. The library was the only portion of the buildings that emerged unscathed from the conflagration.

The foundation stone of the old set of buildings which was laid by King Edward the Seventh, when Prince of Wales, on September 1, 1860, was rescued from the débris and relaid by His Royal Highness the Duke of Connaught on September 1, 1916. On September 1, 1919, the foundation stone of the tower, dedicated to "Victory" and "Peace," was laid by His Royal Highness Albert Edward, Prince of Wales. This stone which rises in the center of the court into a pillar with fan-shaped top forming the vaulted ceiling, represents the motherland in isolation, while at the base of the pillar the sculptor shows the waters of the North Sea leaving the shores of Britain and reaching out across the Atlantic to Canada.

As it stands today the edifice is a triumph for the architectural art. The exterior is of Nepean sandstone, obtained in the vicinity of Ottawa, and the tracery and cut stone work are wrought of Ohio freestone. The main entrance is through the Ceneral Tower which is at present incomplete. The interior of the Commons corridor is lined with Tindall limestone, obtained from the quarries at Selkirk, near Winnipeg, and the stone so delicately freckled is wondrously rich in appearance and clothes the building like something akin to mammoth tapestry. The floors are of boulder-gray marble, flanked at each side with green cross-grained marble. At each side of the Commons entrance white marble steps lead up to the lobby, and the railing and the balustrades are of Rose Travanell marble brought from the Trentino. One of the big features of this lobby is the carving in the pillars by which it is bounded. Each pillar bears the head of a former Prime Minister of the Dominion. Quite unique is the ceiling in this section with its octagon-shaped lozenges of reinforced concrete hanging from slender rods something like forty feet above the gray marble floor. The frames are filled with paintings representing the various portfolios of the Government.

Entering the Commons Chamber one is confronted with the Gothic screen. Wrought iron grills of halberts, guardant and reguardant, with crowns of the same metal and hand hammered, protect the cathedral-like windows which flank the opening. Either side of the chamber is flanked by four steps of the members' desks, the floor being of colored rubber tiling, and down the center leading to the Speaker's chair is a wide strip of teakwood flooring, the spaces between the boards being laid with ebony. One is impressed with the spaciousness, loftiness and the care with which the seating accommodation has been arranged. The ceiling, like the Senate chamber, is 65 feet high and is of a pastel green in shade with panels painted in semi-conventional style. Almost $10,000 worth of 22 carat gold leaf is used in the ceiling decoration.

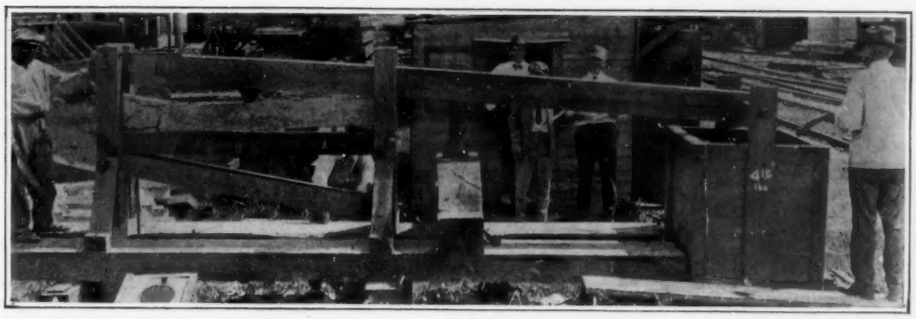
Passing through the government and opposition benches the sight-seer comes out on the north corridor which runs east and west for 475 feet and traveling west along the barrel vaulted south corridor brings one to the main central entrance

(*Continued on page 238*)

Part of the power and water tunnel, looking from the new Parliament building toward the power house

How Strong Is the Concrete?

MANY of the engineers who were formerly employed in the building of the Panama Canal are now engaged in building the canal which is destined to connect the Mississippi River with Lake Pontchartrain, just below the city of New Orleans. This canal will cut down the distance from the Gulf to the city, aiding in the fulfilling of the city's boast, "New Orleans—The Gateway to the Panama Canal."



Novel rough-and-ready scheme for testing concrete strength with the aid of a tank of water of adjustable weight

Many novel engineering devices have been produced by the men in charge of the project, all of which are designed to aid them in bringing about the speedy termination of their tremendous task.

Here we show a crude-looking, though most effective and satisfactory, machine for testing the strain concrete will stand without breaking and the strain necessary to break it.

The framework is made of very heavy timbers, bolted together in the manner shown. Two ledges or shelves are supplied for the resting of the concrete to be tested. The concrete bar in the photograph, which has been broken, is supported on the shelves. At one end of the supporting frame the strain lever is pivoted by means of a heavy bolt. This strain lever is made of a joist measuring thirteen feet in length and eight by eight inches in thickness and is fitted at the test point with a wedge-shaped pressure point.

At the end opposite the pivot a huge water tank has been provided with exhausts on the bottom. This tank is graduated and various heights of the water indicate the weight of the tank, filled to any level.

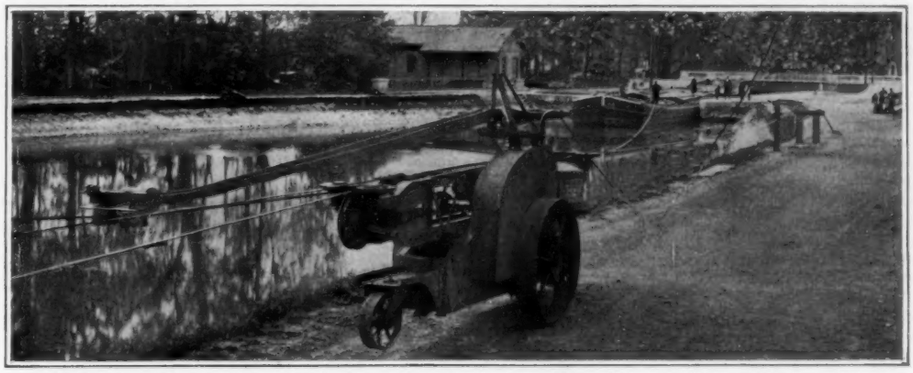
The method of testing the concrete is plainly shown in the photo. The concrete, having been placed on the supporting shelves, the strain lever is lowered until the pressure point comes in contact with the concrete bar. The amount of water in the tank is not, at that time, great enough to break the bar and additional weight is then provided by means of a hose.

After the bar has been broken, the strain lever is again raised by means of the block and jack system indicated in the photo.

By the use of this machine it is possible to test the strength of concrete up to more than a foot in diameter.—By *Arthur H. Lynch.*

The Electric Mule for France's Canals

VARIOUS methods have been proposed for handling canal traffic by mechanical means, and some of these have already come into use to a limited extent. The problem of canal traction is especially under consideration in France, where it is desired to increase the transportation facilities. The little tractors of the Otis-Pifre electric system which we illustrate now appear to solve the problem, for the towpath does not need to be touched, and the tractors being light and cheap can be used with individual canal boats, which is now claimed to be the best method, as against towing a long train of boats. On the new system designed by Engineer Derung, two stationary cables suitably spaced apart are installed along the towpath on the side next the canal, and the tractor is made to run along these cables for the whole length of the towpath and in a practically continuous manner from one end of the canal section to the other. The rear end of the tractor is connected to one or more canal boats by a hauling cable. As will be noticed in our photograph, the small electric tractor has the general shape of a light tricycle of narrow build, and in fact it is not more than 2 feet wide. An electric motor furnishes the power, but precisely what characterizes the present method is that the tractive force is not exerted by the running wheels upon the surface of the roadway, but the electric motor is employed to drive pairs of pulleys which grasp the cable and thus act to pull the tractor along, and with it the canal boat. Special means are provided to prevent any slipping of the cable, and one method consists in the use of a steel band having small projections all along the under side which work together with the pulleys of the tractor. The entire outfit is calculated to draw a loaded canal boat of the usual size at the rate of 2 miles an hour, but even two boats can be towed. One feature is the patented device in the shape of a long arm which is mounted on the tractor and extends in the forward direction, its use being to cause the side pull due to the towing cable to act upon one of the stretched steel cables termed secondary cable, and the whole device is so designed that the mechanical component representing the side pull is entirely taken up by the steel cable.



Electric tractor now in use on the French canals in connection with a stationary traction cable

Current is brought to the motor of the tractor by the usual traveling or hanging trolley which runs along an overhead line and is connected to the tractor by a slack cable. In this way the tractor runs along the road quite in an independent manner without any person to mount or accompany it, being connected to the canal boat by a special towing cable. This cable contains at the same time a certain number of electric wires, for it is found quite an advantage to use electric switches on the tractor which can be controlled by the operator on the boat without requiring a man on shore. In usual operation, the whole outfit runs along from one end of the course to the other and without any disconnecting of the tractor from the canal boat. But it is a very easy matter to uncouple the cable whenever it may become necessary as in the case of repairs, accidents or the like.

Our cover illustration shows one of the Otis-Pifre electric tractors or "electric mules" at work on a typical French waterway, hauling a canal boat along without attention of any kind, to the amazement of the French peasant trudging by with his load of fagots. This matter of electric traction is being widely discussed in France at present, where the canals are destined to play a large rôle in the commerce of the Republic under normal conditions.—By *F. P. Mann.*

Freezing Fish a New Way

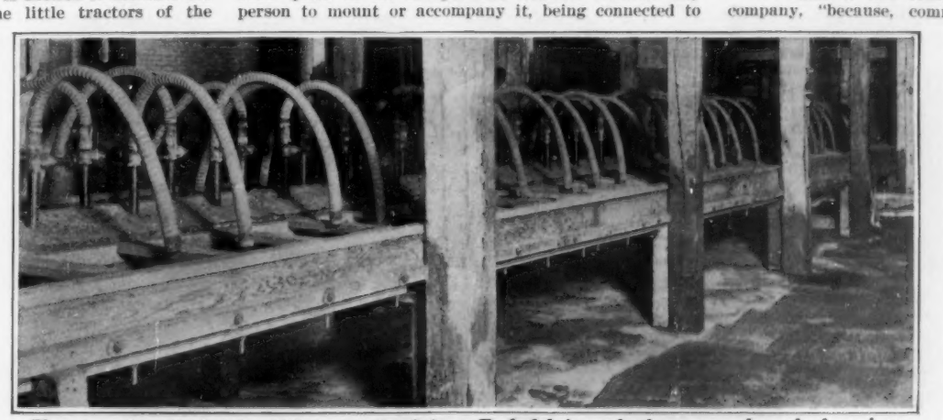
A FISH-FREEZING factory with a capacity of 144 tons a day is now operating in Los Angeles, supplying local markets and shipping to distant ports. It employs an "instant process" absoluteiy new in America, the invention of Nicholi Dahl, a Norwegian.

Three years ago Mr. Dahl, observing the Eskimos' method, centuries old, of hanging their freshly caught fish in icy ocean water to preserve them until wanted, conceived the idea of producing the same conditions artificially. The accompanying view gives some idea of the simple machinery necessary. Through the tubes there is a constant rush of zero-temperatured brine pouring over the trays of fish placed in the trays beneath. This brine is kept in motion, and in an hour's time the freezing of a six-ton supply is complete. Each fish is perfectly preserved and merely awaits the cook's pleasure.

Nor does broiling or frying render it mushy as it did when under the old process which took two or three days, freezing so gradually as to "squeeze out" the taste and much of the food value. These come to the table exactly as fresh fish though transported across the continent.

Shipments made from Los Angeles to Boston, Galveston and South American ports arrived in perfect condition *without icing.* This factory, although the first in the United States and in operation but a short while, is already sending quantities of barracuda, sole, mackerel, halibut and other choice Pacific fish to distant markets.

"We came to this coast," says the president of the company, "because, commercially, the Atlantic seaboard is nearly fished out in comparison to the untouched millions of tons in the Pacific. The world needs this food; the only question is that of conservation and distribution. But between this vast store-house and the centers of population lie the hot deserts and prairie, so a method of preservation, quick, sure and lasting, must be had for this rapidly deteriorating sea food. That we have in the Dahl invention. His plant, the only one until this, operates in Trondjhan, Norway, and this machinery is of his patenting. Improvements in details may be made, but the freezing is perfect."



The apparatus for freezing fish in running brine. Each fish is perfectly preserved, ready for a long journey to the consumer

The Romance of Invention—XX

Thomas Alva Edison—the Man Whose Name Stands for American Invention

By C. H. Claudy

THE name of Edison is, of course, a household word, and most of us know the outlines of his life. That his career constitutes a chapter in the Romance of Invention, and one of paramount interest, is obvious. Indeed, many of our readers have doubtless wondered why we did not set it as the opening chapter in this series. The reason now stands revealed — we were saving it for the closing chapter, for a fitting climax to the story that Mr. Claudy has been telling under this title. So appearing, it is worth noting that the story of Edison comes at a moment when the inventor has just been celebrating his 74th birthday.—THE EDITOR.

IT would be idle to attempt to review, in the space of a magazine article, the activities of the man who is unquestionably the best known of all living inventors. He would be the first to say that other men have invented things as great, as useful, as unusual, as he has ever invented—the first to give credit to the other great scientists and inventors who have brought forth from their brains, ideas, and from their lives, devotion to those ideas, which have resulted in achievements of use to mankind.

But with all the galaxy of brilliant scientists and inventors spread out across a page, it is nevertheless true that the name of Thomas Alva Edison shines forth most brilliantly, for none of those who have preceded him or been his contemporaries has delved in more uncharted seas than has he, or brought to light so great a variety of devices.

It was the writer's good fortune to get an opportunity to listen to Mr. Edison at a moment when he had not too much else running through a very busy mind, to give heed to questions. In the library at Orange, which is also Mr. Edison's office (and sometimes a bedroom, as the much newspaper-storied cot in a corner proved!) the head of the great Edison industries was bending, smiling, over a small paper packet. As he shook hands he drew me over to look at it. "Most unusual collection of industrial diamonds," he said; "look at the colors. We don't get colors like that often. Curious thing, the diamond—two hundred times harder than any known substance and no artificial substitute in sight. It's a good thing there are enough of them, or I should have to go out of business."

This, of course, referred to the fact that the Edison phonograph uses more industrial diamonds than any other industry in the world, and that the inventor has found nothing which can be used to run in the groove of his records which will take the place of the bit of carbon that nature has crystallized.

This seemed a promising "lead" so I plunged in with the question, "Do you think of the phonograph as your greatest contribution to the world?"

"Depends on how you mean 'greatest,'" responded Mr. Edison. "As a matter of pleasure, I suppose the phonograph has given a greater amount than anything I ever did. But industrially, of course, my work in electric light and power was of greater importance."

"How about the motion picture?"

"Oh, well, I am not actively interested in that any more. I never am interested in a thing when it gets to the point where it is a complete success. I want to leave it then and go on to something else."

"Except in the case of the phonograph," put in one of Mr. Edison's assistants.

"Of course, except in the case of the phonograph. That's because, I suppose, I happen to love music. Oh, I don't expect ever to get through with the phonograph. It's not perfect. But it is so perfect that I can't tell, and you can't tell, the difference between the original source and the recreation of that sound with my instrument. It has been proved time and again, with hundreds of different critics and auditors; you cannot tell when a singer leaves off and the phonograph begins or when the phonograph stops and the singer takes up the song. At the same time, the records are not perfect yet, but we get a little closer to perfection all the time, and we never stop working on them."

Inasmuch as the Edison methods of making records and reproducing copies of them, and of making the apparatus for the recreation of sound, are guarded as carefully as ever the government guarded a secret process of munition making, there was no opportunity for me to see the marvels of imprisoning sound in tiny cuts in wax; but there is no secret about seeing the great plant which rose, phoenix-like, from the ashes of the disastrous Edison fire a few years ago, and in which the mechanism of the phonograph is made. It is much as is any other large factory in which quantity production has been accomplished, with the outstanding feature of having as much automatic machinery as is possible and in some cases automatic machinery one would swear was impossible until one saw it work.

Not infrequently one hears the question, "What is Edison doing in his big plant at Orange?"

The answer is "making phonographs and storage batteries, and phonograph records." This is the answer as far as the public is concerned. What Mr. Edison himself is doing, what wonder he is working at in his own laboratory, what particular thing he has in mind to improve or change or produce next, he does not say. He has long passed the point where it is necessary for him to prophesy.

A very large part of his plant is devoted to the making of the Edison storage battery. Inasmuch as the greatest contact of the public with storage batteries in general is in their use in lighting and starting ordinary automobiles, and because the Edison battery is not suitable for this purpose, the general public knows comparatively little of it. Yet it was as revolutionary, when produced, as anything which ever came from the Edison laboratories, and the huge factory, big as it is, cannot now keep up with the demand for these alkaline cells, which are extensively employed on commercial trucks, for lighting of railway trains, and for other purposes.

The Edison battery is made of steel. It has no acid within it. It can be broken by jar or blow but with such difficulty that it is practically indestructible. It never wears out—at least, none has ever yet worn out. It can stand an indefinite period without injury, whether fully charged, half-charged or discharged. It cannot be injured by overcharge or overdischarge. It is far lighter than lead-acid cells and costs less than other types over long periods of time.

All this is possible because, using alkali, steel instead of lead and rubber can be employed, and because it has a completely reversible chemical cycle. Charles P. Steinmetz says of it: "The characteristic feature of the Edison battery, which appears to me as the main advantage, is the complete reversibility of the chemical reactions which occur in it. With these materials—iron, nickel, and their oxides, in caustic potash as electrolyte—no chemical processes can occur which are not electrolytically reversible. From that then would follow that there could theoretically be no deterioration of the battery; that is, no decrease of capacity from use or abuse.

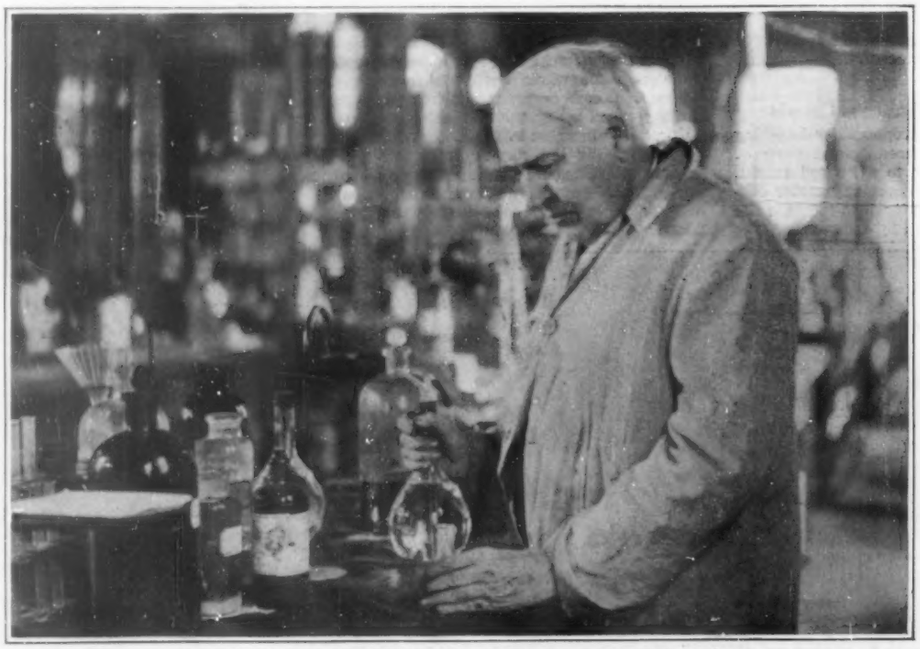
"In this respect the Edison battery appears to me essentially different from the lead battery, in which we know that there is an irreversible chemical process, the formation of lead sulfate, which means that if you discharge a lead battery you can never charge it again to the same capacity, but every successive charge and discharge reduces the capacity, be it ever so little. Therefrom it follows that the life of the lead battery must be limited; that its capacity must gradually decrease until at least one set of plates has to be replaced.

"It cannot be seen how an irreversible process could occur in the Edison battery. All these remarkable features—that you can overcharge it or overdischarge it, can stop it and let it stand charged or discharged or partly discharged, charge it with reversed polarity, the feature that the ampere-hour efficiency is 100 per cent less the electrolytic dissociation of water—are there, while astonishing to one who is familiar with the lead battery, follow as a matter of course from the complete reversibility of the chemical reaction of the Edison battery as obvious results. Inversely, then, the existence of these properties is an additional proof that the chemical reaction is completely reversible; that is, that the battery does not age, has no definite life, but that its life is limited, theoretically, only by impurities finding their way into the cell."

I was interested in hearing what Mr. Edison had to say of his own battery.

"It is of enormous importance because of the shortage of gasoline," he said. "Portable power plants are necessary. Portable power plants mean portable fuel. But liquid fuel from the earth is limited in quantity. Coal is unlimited, practically, we have enough for hundreds of years without considering waterfalls as a power source. With coal and water power to make electricity and an efficient means of storing that energy by a battery, we can be independent of gasoline for many purposes for which it

(*Continued on page 238*)



Thomas Alva Edison, America's seventy-four-year-young inventor

Road Building Simplified

HARNESSING natural resources as hired men to labor and expedite the building of concrete roads has resulted in unique achievements in Sacramento County, California. It so happened that a permanent highway was to be constructed along the banks of a small river. The highway engineer in charge of the work immediately capitalized this natural advantage by purchasing several barges upon which he installed his concrete mixing machinery. This arrangement greatly facilitated the work. The entire equipment could easily be moved from one location to another as work on the highway progressed while the water necessary for moistening the mixture of cement, sand and crushed rock was readily pumped directly from the river, thus eliminating the need for hauling or piping water long distances. Fortunately this water was not of an alkaline character objectionable for concrete purposes as are some of the natural waters of the country under discussion. This is the second time in the engineering history of the Far West that natural advantages of this type have been so utilized in road construction activities, the other case having occurred several years ago in the State of Wyoming.

Jacking Up a Road

WITH as little seeming formality as one would jack up the rear wheels of an automobile for repairing nail-perforated tires, a section of highway near Las Cruces, New Mexico, was saved from costly damage of a powerful washout by unusual methods. The undermining influences of heavy rains deprived the sandy subgrade of its sustaining powers which in turn left the concrete slabs with but frail support. The exigency for immediate action taxed the ingenuity of the engineer of the United States Bureau of Public Roads, who quickly adopted the novel procedure of jacking up the road bed and rammed wet sand into the rain-washed dug-outs as a support for the concrete slabs.

The collapse of the pavement was averted, and as a tribute to the material employed and the workmanship engaged in building the highway the concrete slabs were restored to their former bed without having developed a crack or flaw. Until the sandy subgrade could be rebuilt the washed shoulders of the road were protected with brush as a precaution against further erosion in the event of another gully-washing rain. The undercut gaps in the subgrade were rapidly refilled and consolidated. Where the slabs had departed from the true line of their original formation, wooden stringers were inserted under them near the outer edge. The concrete was elevated to its correct position by use of hand-operated jacks bearing on the stringers. Once the slabs were reinstated to the proper grade cribbing was placed under the stringers and the jacks displaced. Forthwith the sand was restored as a support to the slabs, previous wetting contributing to its consolidation. The latter accomplishment was insured by use of a heavy ram, suspended from a tripod, and operated by four men.

A Choice of Color in Tomatoes

DOWN in eastern Texas they grow two kinds of tomatoes for shipment—pink and green. This section is not so distant from Northern markets but that tomatoes despatched in the pink stage will arrive red and in good condition for consumption. On the other hand, the shipment of tomatoes green is practical here as elsewhere. The tomato is a precocious vegetable. Picked in the grass-green stage and given sufficient time, it will ripen up and acquire color.

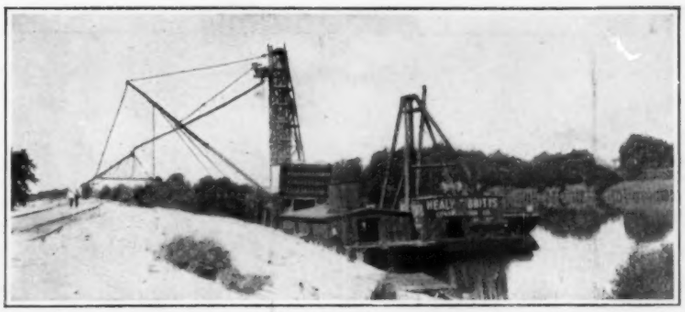
The longer a tomato stays on the vines the better it is when it reaches the red stage. In eastern Texas formerly the whole commercial acreage was handled for the shipment of fruit pink. It could be left that long on the vines, and still be got north in a not over-ripe condition, and consequently it was.

That's logical enough, but it didn't prove wholly profitable enough to suit many growers. A few started to ship fruit green. They made money, which is the final test of any cultural method. The green tomato industry developed apace. There were very tangible economies of production and getting to market. With green stock the vines could be allowed to run wild, in a manner of speaking, but with pink stock they must be pruned, given supports, cared for with considerable diligence. There was much greater danger of frost damage with the pink. The open vines which welcomed the sun and facilitated quick ripening also invited the frost.

Green tomatoes go to market wrapped, in crates. Pinks are shipped under refrigeration. No one claims a tomato picked green ever makes better eating than one picked pink, but the acreage in eastern Texas of pink stock is dropping and the acreage of green is growing to vast proportions.

Florida also ships many hundreds of cars of tomatoes picked green. Research work has shown the relative importance of some of the factors affecting ripening of green tomatoes. This early-picked "tom" gets its color in ripening rooms, while rolling to market, and after arrival there. If it is picked too green, it ripens slowly, tends to wrinkle, doesn't color right, and has a bad taste and flavor. Strangely enough ventilation in quarters where tomatoes are ripening is very important. In a room without ventilation, acid content increased 138 per cent over vine-ripened fruit, while sugar content decreased 21 per cent.

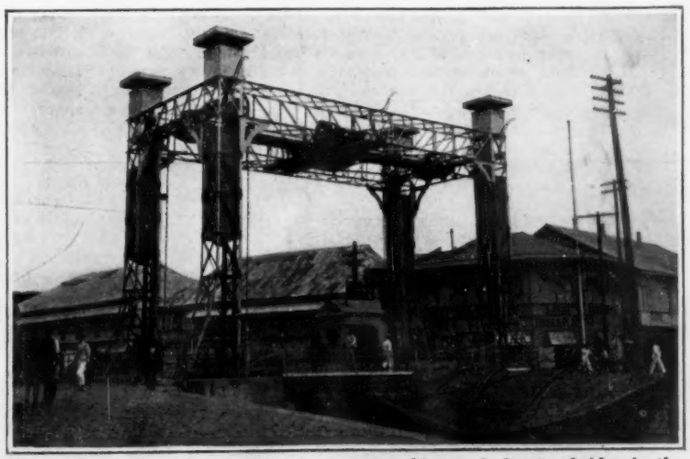
Wrapped greens also develop more acid than unwrapped, as they also are more deficient in sugar. In practice, the green tomato industry determines just how far it can go in decreasing costs to advantage, and stops as near that point as possible. At best, the tomato picked green never equals the vine-ripened, or even the pink, but in the race for farm profits green is the chosen tomato color down South.



A rush-order method of road building, where the machinery for mixing and distributing the concrete is moved by boat. The gravity chute permits the rapid pouring of the concrete batch

Jacking up a concrete road in order to repair the subgrade which has been damaged by heavy rains. Hand-operated jacks bearing on stringers have been used for the purpose. The arrow indicates the ram

A pre-cast California concrete bridge which is three miles long and is a modern marvel of road building. The piers and parts forming the base of this structure were made on land



The mere pressing of a push-button operates this novel elevator bridge in the city of Manila. Electric motors at the top do the lifting, aided by counterweights in the four uprights

An Instalment Plan Bridge

A REMARKABLE illustration of the outstanding road construction activities which are making California the leading highway building state in the country is the pre-cast concrete bridge which is aiding the Golden State to solve some of her thoroughfare problems. The piers and parts which form the base of this cross-water structure are made on land and, subsequently are freighted out to the point of construction where they are bedded in place on permanent foundations. Once the superstructure is in place, the work of laying the roadway proper is vastly simplified and facilitated. The concrete causeway presented in the accompanying illustrations is three miles long and a marvel of modern concrete construction.

Manila's Push-Button Elevator Bridge

IN order to permit junks and other native craft to pass through the canal shown in the accompanying view, the city of Manila has constructed an ingenious elevator-type bridge which is operated by the mere pressing of a push-button. The roadway of the bridge is raised by electric motors to a height sufficient to clear the superstructure of any native craft passing through the canal. Counterweights moving in the four uprights of the bridge serve to balance the moving member, just as in the usual elevator construction.

Fifteen-year-old growth of Japanese larch, after preculture

Young maritime-pine stand for which the ground was prepared by preculture

Making a Forest to Order

An European Innovation in Preparing the Soil for the Trees Which It Is to Support

By Henry Vendelmans

FORESTRY by precultures is the most remarkable innovation in modern forestry, and it has been attended with such striking success that it is being widely adopted. It can be applied practically everywhere, but it is most effective on poor land where otherwise nothing could thrive. It is based on the improvement of the soil to such an extent that it becomes suited to the varieties of trees which have been selected for planting. It not only allows good woods to be raised on land which by itself would be unable to yield any timber, but also more exacting, more valuable varieties of trees can be produced on many kinds of available land than would otherwise be possible.

Often, however, woods could hardly afford to be charged with the whole expense of the precultures required to make an effective improvement; and even if they could, it would probably not be wise to do so, because the outlay would be unnecessarily heavy. Therefore the precultures are generally followed up by agricultural crops which sometimes leave a profit, but more often pay for the expenses incurred, or at least reduce them to such an extent that forestry is made under greatly improved conditions at a very small cost.

Planting fir seedlings with a special spade used for this purpose only

Forestry by precultures puts work on a different footing altogether from where it stood before, placing it finally within the scope of agriculture, where, after all, it really belongs. The first result of this close cooperation furthers the question of tree raising to a great extent. Its success largely depends upon the appropriate improvement of the soil, while the outlay and the financial results are greatly influenced by the yield of the crops.

When forestry and agriculture share between them the area of the estate, mainly to forestry are allotted such parts of the land as would not be well suited to permanent cultivation from the point of view of the nature of the land, the climate, or the local conditions. Tree plantings are now made frequently also for the purpose of providing shelter to crops against cold or dry wind, and sometimes also to suit the owner's convenience; in each of these cases returns are a consideration, and as forestry is a long deferred investment, a reduced outlay is of the utmost importance. From that point of view also the method is most interesting. Even now, under favorable conditions, it would allow good tree plantings of Scotch firs or other varieties to be made at a very favorable cost. In England this work has been carried out at about $5.00 to the acre, all told, which is remarkably low and is not to be compared with other methods in vogue in that country. The method consists of preparing the land, improving and appropriating it to the intended tree planting, which is then executed at the lowest possible cost. It has for its object to destroy the natural vegetation covering the land, which instead of being a hindrance, is turned to good account by adding to the humus; to break up and aerate the soil and insure water evacuation; to amend the soil and add to its mineral content by applying lime and chemicals; to improve further its physical condition by increasing the power for retaining water; to enrich it with available nitrogen and with bacterial flora by using green manures; to make the agricultural crop which follows the green manure pay for the expenses and to provide a most appropriate medium in which to plant at small cost with the maximum percentage of growth. Moreover, the surface being clean yearly seedlings are used whenever possible, and the woods are installed with the best prospects of success. In some instances sowing tree seed into the corn can also be resorted to, while in other cases untransplanted two-year-old seedlings are used to advantage.

Breaking up the soil with ox plows for the reception of trees

It must be clear that close association between agriculture and forestry alone could bring about the best results.

In preparing the land it is often necessary to clear the field before plowing can be carried out. Favorable land is plowed to a depth of 8 inches; sometimes, however, it is necessary to go as deep as 14 inches, but only when either the soil is particularly hard and the subsoil unfavorable or when hardpan exists can plowing 20 inches deep be justified. In the case of hardpan within 20 inches of the surface, it is generally sufficient to plow 14 inches deep and to subsoil to the required depth, because either the subsequent improvements and the applied changes act sufficiently on the cement of the pan, or the roots of the trees reach that depth sufficiently in time to prevent the hardpan from being formed again to such an extent as to do any harm. When hardpan occurs at about 25-30 inches deep, it is sufficient to break it at intervals by using either the ditching plow or explosive. It is considered important to use a plow which makes wide furrows (from 14-20 inches), and turns the soil completely so as to cover and smother effectively the natural vegetation; it must also have a good clearance-space where plowbody and beam meet. For ordinary land there are several suitable plows, but in rocky land most of them are liable to get damaged; therefore a plow answering to the following description should be used: It should be light (about 140-150 lbs.), so as to be handled and put back easily into the furrow when it has been thrown out, but strongly and simply built so as to stand the strain (bolts come undone easily). Its beam should be short and double, its handles short, too. It should be provided with a swivel skeith. The share should be crested and of chilled steel. It is strong and lasts a long time, but when broken or worn out it is easily replaced. The plow should be built to cut normally at least 14 inches. Only single plows can be used. A team of two strong steady horses is more valuable in this instance than on any other occasion; a 3-horse team could easily put out of order a plow of the above description. Even where no agricultural crops are taken, when the soil is deficient in lime and it is intended to carry deciduous plantings or calcicolæ coniferous trees, from ¾ to 1¼ tons of burnt quicklime,

(*Continued on page 240*)

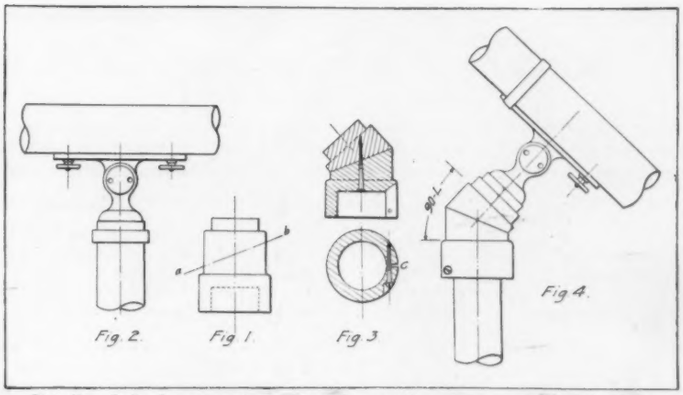
Portable Telescope with Equatorial Mounting

As far as the present writer is aware, all of the portable telescopes that are now available are provided with tripods that support the central standard, which is adjustable as to height and permits the instrument to move around a vertical and a horizontal axis—the usual alt-azimuth mounting. To follow a star, both axes must be adjusted, and with the higher powers one is very apt to overadjust in one direction and thus lose the star being observed.

Confronted by this inconvenience the writer changed, at a trifling expense, such a telescope into one provided with an approximate equatorial mounting, and thereby made it possible readily to follow a star as long as one cared to with only one adjustment, and that, the easier of the two. The instrument was merely lined up by the marks on the cement sidewalk, but the arc generated was so nearly equatorial that it was possible to place the star well over to one side of the field and then turn the instrument over to another spectator without any danger of losing the star.

To accomplish this, glue up several pieces of hardwood to make a block large enough to turn up to the shape indicated in Fig. 1. The base is turned out so as to fit over the central standard in Fig. 2, which shows the mounting of the instrument as originally built. The upper end of the block should be turned to fit tightly into the brass cap that fits over the standard. The block is then carefully sawed in two along the line *a-b*, the angle of which is equal to 45° minus half the latitude. The piece removed is then turned 180° and replaced as in Fig. 3, the two being joined with glue and one or more large screws. A saw cut is made at *c*, and a large screw fitted in so that the block may be tightly clamped to the standard. After applying a coat of weatherproof paint, clamp in place, and then fasten on the present mounting with several small screws, so that the general arrangement is as shown in Fig. 4. What was originally the vertical axis is now the polar axis.

As the telescope will probably no longer be balanced, it may be necessary to tighten the pivot somewhat, and to move the point of clamping farther from the eye-piece. It so happened that with the instrument used by the writer this was accomplished by abandoning the inner screw and placing the outer screw in the hole formerly occupied by it, a small strap being used at the outer point.



Details of the home-made equatorial mounting for a portable telescope

Curious Habits of Lampreys

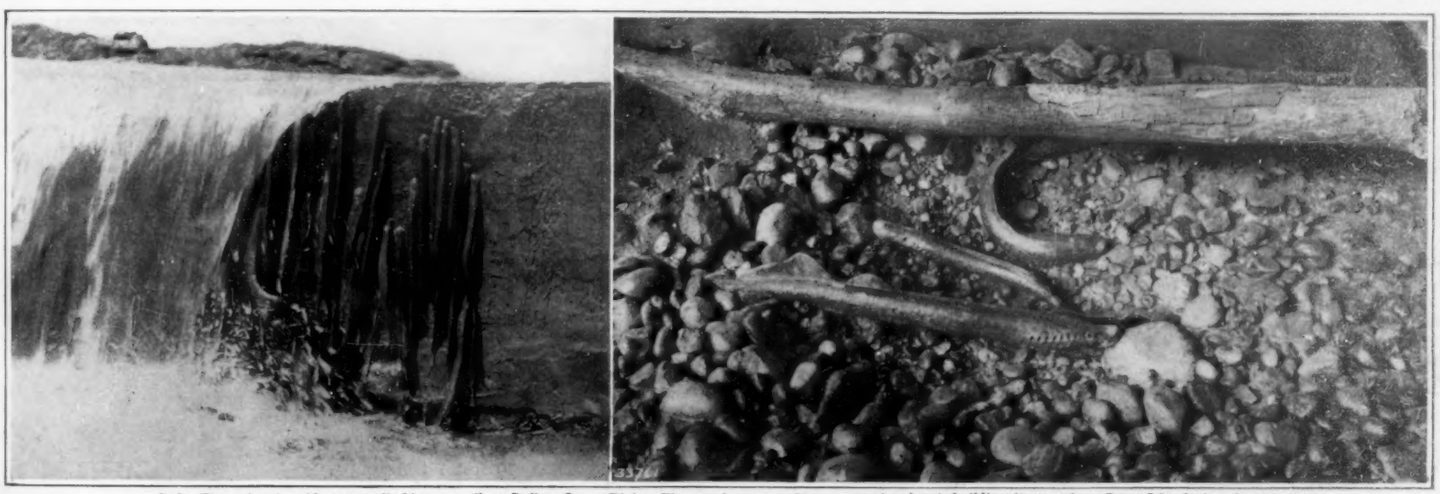
LAMPREYS are commonly thought to be fish and they are very generally called lamprey eels, because of their long, sinuous, snaky forms. As a matter of fact, however, they are not only not eels but they are not even true fish. They differ from the latter in several important features, the most marked of which is that they possess no jaws, but have instead extremely curious round mouths with which they are capable of exerting powerful suction. Furthermore, they have no traces of limbs, and their skeletons are cartilaginous in nature. A marked feature in lampreys is the seven gill openings on each side of the body, just below the eye.

The mouth is a sort of rounded disk covered with rasp-like teeth and having a tongue which has still stronger and sharper teeth arranged in rows like the teeth of a comb. With this formidable instrument lampreys attach themselves to other fish, especially those whose bodies are comparatively soft and literally rasp away the surface to which they cling, sucking the blood and swallowing the flesh of the unfortunate victim. It is with this curious mouth, too, that they pick up and carry away the stones in the river bottoms where they make their nests at the time of spawning.

Since lampreys are quite abundant, not only in the Atlantic and Pacific Oceans but also in lakes, rivers and brooks, it will be seen that they constitute a very serious menace to many of our food fishes. A striking example of this is in the case of the common bullhead or pout. This popular food fish is one of the most important fish on the market in New York, being caught by thousands in the early part of June when it is getting ready to spawn. Professor Gage of Cornell University, who has made a special study of lake and brook lampreys, particularly in Lake Cayuga where they are found, tells us that he has at times seen more than 90 per cent of the catch injured by lampreys, and warns us that the attacks of "this terrible parasite" are surely devastating our lakes and streams.

A characteristic feature in the life of lampreys is the curious metamorphosis which they undergo. When the young first come from the egg they are slender and eyeless, and their mouths are narrow

(*Continued on page 240*)



Left: Entosphemia tridentatus climbing a wall at Dalles, Ore. *Right:* The sea lamprey (Petromyzon inarinus) building its nest in a Long Island river bottom

Two species of lampreys engaged in characteristic activities

A Novel Equal-Area Projection of the Sphere

A PROJECTION of the whole sphere on an equivalent or equal area system devised by Aitoff, has been issued by the United States Coast and Geodetic Survey, size 11 inches by 22 inches at the price of 15 cents.

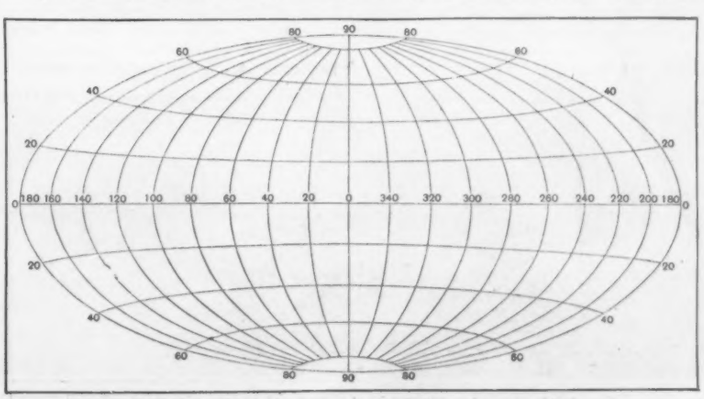
The sphere is represented within an ellipse with major axis twice the minor axis. No shoreline has been included since it is intended primarily for the plotting of the stars in astronomical work, its value for this kind of work being suggested by Professor Benjamin Boss of the Dudley Observatory, Albany, N. Y.

The projection is bounded by an ellipse similar to that which is used in Mollweide's equal area projection but, since the parallels are curved lines, the distortion in the polar regions is less in evidence. The network of meridians and parallels is obtained by the orthogonal or perpendicular projection of a Lambert meridional equal-area hemisphere upon a plane making an angle of 60° to the plane of the original.

The fact that it is an equivalent or equal area projection combined with the fact that the celestial sphere is represented in one continuous map, will show at a glance the relative frequency of stars in the different regions of the expanse of the heavens. As constructed the radius of the sphere to be projected is taken as a decimeter so that the graticule has a very convenient size for general use.

As used for a map of the world, this projection is well adapted to replace the Mercator projection in atlases of physical geography or for statistical purposes and has the advantage over Mollweide's in that its representation of the shape of countries far east and west of the central meridian is not so distorted because meridians and parallels are not so oblique to one another.

By employing the meridian of Greenwich as a central meridian, the continental masses can be mapped where the projection is at its best and the greater distortion transferred to the Pacific Ocean.



The equal-area projection of the sphere into an ellipse

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Two-ton trucks and trailers handling casing during a freight embargo

Trucks Show Way Around Embargo

IF drilling is to continue without interruption so that leases can be held and production increased, casing for new wells must be had, and quickly. That, in brief, is the situation that confronted officials of the Skelly Oil Company, of Tulsa, Okla. Aggravating the situation was the knowledge that 40 carloads of casing long on order with a prominent iron and steel company, were ready for shipment at Youngstown, Ohio, but could not be moved because the freight embargo then in effect in the Youngstown district was as confining as a health officer's quarantine sign. Casing in Youngstown was of discouragingly little use in Tulsa, more than 2,000 miles distant. Then it was that a coincidence and faith in motor trucks combined to overcome the difficulty. It was a coincidence that the Skelly Company at the moment of their need should have had an order with a truck manufacturer at Cleveland, Ohio, for twenty more 2-ton trucks for their fleet. It was faith, however, born of satisfactory experience that led the Skelly officials to think of their trucks at this time and to believe that they could solve their problem.

Consequently executives of the company began to "burn up the wires," so to speak, between Tulsa and Cleveland and they did not cease until arrangements had been made to commandeer the first three units of the Skelly fleet, then nearly ready to leave the factory. When the trucks were ready, the executives came on from Tulsa, bringing with them an experienced oil field driver to take charge of the trucks. Other drivers were hired in Cleveland and the three trucks were then driven to Youngstown.

There, oil field experience really began. Freight cars were still unobtainable in the steel city. However, at Leavitsburg, exactly 25.1 miles from the steel works, a car or two at a time was to be had, which was better than none at all. So, augmented by two trucks hired for the occasion, the trio of trucks set to work, hauling 6⅝-inch and 8¼-inch casing from Youngstown to a railroad siding in Leavittsburg. Two round trips were made daily by the trucks and trailers, each combination hauling an average of five tons to the load, about 25 pieces of the 6⅝-inch casing or 15 to 18 pieces of the 8¼-size. Four carloads of the 8¼ casing, weighing 32 pounds to the foot, were consigned to Breckenridge, Texas. About 22 cars were loaded with 8¼ casing, weighing 28 pounds to the foot. The balance of the 40 cars were loaded with the 6⅝-inch casing, weighing 20 pounds to the foot.

An average of nearly two cars a day were loaded and headed for Texas, or for Tulsa, Wilson, or Beggs, Oklahoma. About 88 pieces of the 8¼-inch or 100 pieces of the 6⅝-inch constituted a load for a single deck freight car, amounting to between 110 and 120 pieces of the larger size and 146 pieces of the smaller size casing for the double deck cars. Three weeks of such training was real conditioning work for the long trip which lay ahead of the trucks. The casing on its way, the trucks were ready to follow suit. With trailers securely boomed on as ballast, the trucks set out on a 2,000-mile roll to Oklahoma, then to Texas border.

Real Work for the Trailer

DURING the recent shortage of freight cars numerous manufacturing companies had to turn to the motor truck as a sure and rapid means of getting their supplies. A case in point was a motor car manufacturer of Springfield, Ohio, who had considerable trouble in getting freight space; he was actually tied up for want of transportation facilities. And when this manufacturer could get freight accommodations, it would take just one week to bring a carload of bodies from Muncie, Ind., to Springfield.

A general trucking concern of Springfield came to the rescue with motor trucks and three-ton trailers with 22-foot chassis, the trailers being fitted with special racks. Our illustration shows one of the outfits loaded with 21 of the light-six touring car bodies—a load equal to that handled by a 40-foot railroad car. These bodies were transported from Muncie to Springfield, a distance of approximately 100 miles. The round trip was made with truck and trailer in 20 hours, and this included the loading and unloading time. The trailer, it will be noted, is of the automatic tracking type, permitting it to follow the trucks even around the sharpest curves.

Motor truck and three-ton trailer carrying 21 automobile bodies weighing 10,500 pounds over a distance of 100 miles during railroad car shortage

Ditch Digging by Machinery

AN excellent example of the way the internal combustion engine is applied to lighten the labors of mankind is shown in the accompanying illustration, which depicts a new model excavator or ditch digger with side wheels. This machine was designed to fill the demand for an excavator able to dig close to curbing, pole lines, walls, and to operate in other restricted quarters where a trench is to be dug. This ditcher, with standard side clearance cutters, is designed to dig a trench 15 inches wide to a maximum depth of 4 feet. By increasing the width of the side clearance cutters the machine will dig a trench to a maximum width of 24 inches. The power is furnished by a heavy duty four cylinder engine of the water-cooled type. Corduroy grip tractions are provided for supporting the rear or heavy end of the machine. The engine is rated at 25 horsepower and is of the tractor type arranged for burning either gasoline, kerosene or distillate.

The operating levers are placed at the back of the body of the machine and are so grouped that they may all be reached by the operator from his position on the rear platform where he can always keep one hand on the steering wheel. The digging wheel is of the open type without axle and arranged to obtain a trench of maximum depth with a minimum diameter of wheels. The hoisting drum for raising and lowering the wheel frame is mounted on the car body and connected with the jack-shaft by means of a steel roller chain. The steering mechanism is mounted under the frame and is operated by a worm and worm-wheel. A steel belt conveyer is used for removing the material dug up and is 24 inches wide and of sufficient length to dispose of material when digging at the maximum depth. The general dimensions of this ditcher are: Width, 10 feet 7 inches; length of car body, 18 feet; length over all, 25 feet 9 inches; height over all, 9 feet 7½ inches; weight on corduroy grip traction, 19,500 pounds.

Trucks Used by Sugar Growers

ONE of the latest industries to adapt the motor truck to its transportation demands is that of the sugar cane and sugar beet growers. Sixty million tons of sugar cane or more are handled every season between the United States and Cuba. Up to now expensive and slow two-wheeled ox carts handled the bulk of this cane. The same is true in the sugar beet industry where a hundred thousand American farmers grow ten million tons of sugar beets which

Gasoline-propelled trench digger which speeds up digging and reduces costs

have to be hauled at an average of four or five miles from the farms to the factories or beet dumps. Here again the slow and expensive horse-driven transportation method has been responsible for delayed deliveries and expensive labor.

Up to a short time ago, the motor truck had not been tried out by the sugar industry, but gradually after demonstrations had been held in which it was proven that the motor truck was capable of carrying more tons longer distances in a shorter period of time and at less cost, the growers realized that it was to their benefit both from an efficiency as well as an economy and net income standpoint to supplant the old-fashioned methods with the modern motor truck.

Especially is this true when it has been found that by equipping motor trucks with pneumatic tires a capacity load can be hauled from the field over soft ground just as effectively as if an invisible macadamized road led up to and into the beet fields. This ability on the part of the motor truck to transport sugar beets or sugar cane from the ground to the factories or beet dumps has not only decreased the time in harvesting, but has made an enormous saving in the cost of labor, permitting owners to accomplish the same amount of work in less time and with less help.

Electric Vehicles in Italy

THE shortage of gasoline during the war has brought about a considerable use of electric trucking vehicles in Milan, Italy, more particularly for heavy work. Although under normal conditions gasoline will not continue at its present price of $1 a gallon, it will always be high in Italy and the cost of electricity is comparatively low. The cities of the Po valley are level and the roads good. There is one electric garage in Milan which operates electric buses for all the hotels and also a regular express truck service between Milan and Bergamo. This concern is organizing a corporation to manufacture and handle electric vehicles.

Reorganizing the Port of New York

(*Continued from page 224*)

and light merchandise. The defect of this system is that it is *far too limited to be a satisfactory solution of this great port problem.* A careful and unprejudiced reading of this report must convince every serious student of the problem, as it has convinced us, that as a solution of the problem presented by the obstacle of the Hudson River and the free interchange of passenger and freight traffic, the system of tunnels proposed cannot be compared with the proposed North River Bridge with its additional annual capacity for carrying 250 million passengers, from 25 to 30 million vehicles, and all of the heavy freight across the river—elements of the transportation problem for which the proposed tunnel makes no provision whatsoever.

From the Einstein Contest—IV

(*Continued from page 226*)

jective universe: but they will disagree as to its composition in space and time separately. In short, space and time are *relative* conceptions; their relativity is a necessary consequence of the relativity of motion. The paradox named at the outset is overcome; for the two observers measuring the velocity of the light produced as they passed one another, were using different units of space and time. And hence emerges triumphant the *Special Principle of Relativity*, which states that the laws of nature are the same for all observers, whether they are in a state of rest or of uniform motion in a straight line.

Uniform motion in a straight line is however a very special kind of motion. Our experience in ordinary life is of motions that are neither uniform nor in a straight line; both speed and direction of motion are altering. The moving body is then said to undergo "acceleration:" which means either that its speed is increasing or diminishing, or that its direction of motion is changing, or both. If we revert to our former supposition of a universe in which there is only a single body in "empty" space, we clearly cannot say whether it has acceleration any more than whether it is moving, there being no outside standard of comparison: and the General Principle of Relativity asserts the invariance of the laws of nature for all states of motion of the observer. In this case, however, a difference might be detected by an observer on the moving body itself. It would be manifested to him as the action of a force; such for instance as we feel when a train in which we are traveling is increasing or reducing speed, or when without changing speed, it is rounding a curve. The force dies away as soon as the velocity becomes uniform. Thus acceleration reveals itself to us under the guise of action by a force. Force and acceleration go together, and we may either say that the acceleration is due to the force, or that the impression of force is due to the acceleration.

Now when we are traveling with accelerated motion, we have quite a different idea of what constitutes a straight line from that which we had when at rest or in uniform motion. If we are moving at uniform velocity in an airplane and drop a stone to the earth it will appear to us in the airplane to fall in a straight line downward, while to an observer on the earth it will appear to describe a parabola. This is due to the fact that the stone gathers speed as it falls: it is subject to the acceleration associated with gravity. Acceleration obliterates the fundamental difference between a straight and curved line. Unless we know what is the absolute motion of the stone, and the two observers, we cannot say whether the line is "really" a straight or a curved line. Since absolute motion is an illegitimate conception, it follows that there is

(*Continued on page 237*)

"Starrett saws have convinced me they are best, by test. The blade that cuts quicker and cuts longer, cuts labor costs, too."

But for a blade to cut quicker and last longer, it must be the right saw for the material to be cut. Many saws will cut more than one metal. But no saw will cut all metals equally well. The pitch of the blade, for example, varies according to the kind of material cut. Cold-rolled stock and machine steel are cut efficiently with the saw that has 10 teeth to the inch. But brass and soft metals require a fine-toothed blade. And pitch is but one of the things to be considered in selecting the right blade.

To make it possible to select the saw best suited to a particular kind or shape of metal the Starrett Hacksaw Chart was designed. Use it, it will help you cut your cutting costs.

A copy of the chart will be sent free upon request. Send for Catalog No. 22B.

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The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
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Use Starrett Hack Saws

Essence of Hack Saw Efficiency

The sum and substance of all Hack Saw efficiency is—how long should it take to cut any particular piece of work, and how many cuts should a blade be expected to make before it is dulled?

As is shown in "Hack Saws and Their Uses," published by The L. S. Starrett Company, the characteristics of the metal which is being cut is the most important factor in determining how long it will take to cut it and, as every machinist knows, no two pieces of steel or iron are exactly alike as regards hardness, chrystalline structure, etc. Therefore, no hard and fast limits regarding the cutting time of various saws nor their life can be given nor can it be said with certainty, just how long it will or should take to cut any given piece of material. We can, however, take the average of as many cuts of each class of materials as possible and say that, if such of the factors as are under the control of the operator are made to conform to the recommendations given in this treatise, this average represents approximately the time in which a certain material should be cut and, in the same manner, we can say that it is reasonable to expect that a certain blade will deliver approximately so many cuts before becoming dull.

The Cost of the Saw

The cost of the saw is always small—practically negligible—as compared with the value of the time of a man to use or tend it. Seldom, in fact, does the saw cost as much as an hour's ordinary wage. The total difference in cost between the best and the poorest saw is so slight as to be hardly discernible when reduced to the cost per cut, or even to the cost per hour of its useful life. For comparison with hourly labor cost, it is convenient to divide the cost of the saw by the hours it endures and thus get an hourly rate.

Recently Patented Inventions

Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING MACHINE.—J. HALLSTEAD, 1745 Montgomery Ave., Bronx, New York, N. Y. Among the objects of this invention is to provide a flying machine in which the power elements are devices rotable around a horizontal axis transverse to the line of flight and comprising a plurality of wings which have many of the characteristics of the wings of an airplane, but which include a plurality of parallel blades pivoted along one edge and movable with respect to the general plane of the wings.

FEATHERING WHEEL.—A. L. PAULSEN and J. G. PORTER, 914 Macdonald Ave., Richmond, Cal. This invention has for its object to provide a wheel of the character specified especially adapted for flying machines, by means of which the machine may be made to ascend or descend in a nearly vertical manner, and to hover over a comparatively small area or to move forward in the manner of an airplane's flight.

Pertaining to Apparel

CONVERTIBLE SCARF AND SWEATER.—AMELIA BONHEUR, c/o Hotel Ansonia, New York, N. Y. The invention relates to a scarf arranged to permit the user to wear the garment either as a scarf or a sweater. Another object is to provide a garment of the type mentioned which is very simple in construction and adapted to be folded into a small bundle when not in use, for storage or transportation.

NECKTIE RETAINER.—C. SJOMAN, Box 2417, Winnipeg, Manitoba, Canada. An object of the invention is to provide a necktie retainer which obviates the necessity of passing a tie around a collar, but which will permit the use of an ordinary four-in-hand tie with a collar, such as a soft collar, the tie being quickly fastened in position and held securely. A further object is to provide a retainer which does not necessitate the untying of the tie, but retains the same in condition for instant attachment.

SUSPENDERS.—W. E. HEDGER, c/o Box C, Waupun, Wis. This invention relates generally to garment supporters. The object is to provide a connection between the main straps at their point of intersection permitting of relative movement without in any way impairing the efficiency of the connection. Another important object is to provide suitable means for rendering the connection adjustable in order to permit of regulation at the point of intersection to conform with the body length of the wearer.

Of Interest to Farmers

MARKER FOR CORN PLANTERS.—F. HANSON, R.F.D. No. 4, Box 36, Exira, Iowa. The foremost object of this invention is to provide a simple device attachable to a corn-planter for marking the rows to be planted. Another object is to provide a marking device for the purpose described, which is light in action so as to avoid the usual objectionable drag on the horses.

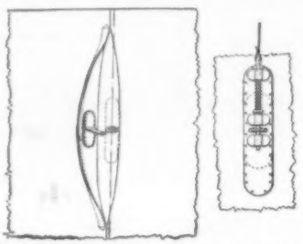
NOZZLE FOR ORCHARD HEATERS.—A. N. COOPER, Filer, Idaho. The object of the invention is to provide a nozzle which may be adjusted to various positions, the lower surface of the nozzle being relatively flat to permit the nozzle to rest on the ground surface and direct heat from the system associated therewith, upwardly into the branches of the trees to be heated.

WEEDER AND CUTTER.—F. F. COOK, 12 Frey St., Newark, N. J. Among the objects of the invention is to provide a hand-operated device which can be easily operated by a single operator and conveniently adjusted to cut the weeds between rows of any desired width. A further object is to provide a device which can be equipped with any desired number of cutting blades in accordance with the thickness of the weeds to be cut.

Of General Interest

HATCH COVER AND BATTING-DOWN CLAMP.—J. PETERSON, 206 Moravan St., Philadelphia, Pa. The invention relates to hatch coverings for ships and has for an object the provision of an arrangement whereby the cover may be quickly applied and removed without injury in any kind of weather. A further object is to provide a series of pivotally mounted clamps along the edges of a hatch for clamping the covering tarpauling in place.

POCKET LOCK.—B. LEVY, 38 E. 32nd St., New York, N. Y. The particular object of this invention is to provide a lock designed for preventing pickpockets from removing the contents



PERSPECTIVE VIEW OF SIDE-POCKET AND REAR VIEW IN LOCKED POSITION

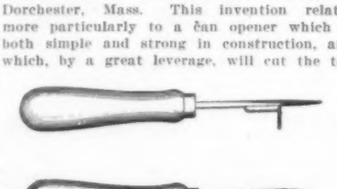
of a pocket. A further object is to provide such a lock which may be used on trousers, coats, vests or any other garment and which will securely lock the pocket so that the contents cannot be removed until the lock is released.

FOUNTAIN PEN INDICATOR. — A. O. DAHLBERG, College of Engineering, University of Wisconsin, Madison, Wis. An object of the invention is to provide a device which will indicate the amount of ink contained in the fountain so that the user of the pen may know when it is running dry. A further object is to provide an indicator which may be used with practically any form of pen now on the market.

EXERCISING APPARATUS.—J. J. COOPER, c/o Jack Reducycle Co., 56 W. 47th St., New York, N. Y. Among the objects of the invention is to provide a portable exercising apparatus arranged to subject the user to the beneficial action of a vapor or Turkish bath while undergoing gentle physical exertion, such as actuating a stationary machine to simulate a bicycle. Another object is to produce copious perspiration solely by the action of the vapors but while the body is in motion. The heat and degree of physical exertion may be controlled by the user to suit his requirements.

Hardware and Tools

CAN OPENER.—A. W. GUILD, 2 Thane St., Dorchester, Mass. This invention relates more particularly to a can opener which is both simple and strong in construction, and which, by a great leverage, will cut the top



EDGE AND SIDE VIEW OF THE OPENER

from a can close to the rim without leaving jagged edges. An object is to provide a can opener in which the cutting stroke is upon the downward movement of the opener, and not upon the lifting stroke, thus rendering the can less liable to slip from the hands.

FLAT IRON.—O. H. DESMARAIS, 26 Passaic St., Hackensack, N. J. Among the objects of the invention is to provide a removable handle for a flat iron of a most reliable nature and of cheap construction, which renders it impossible for a heavy iron to be dropped because of slippage, breakage, or other failure of the handle or its attaching means.

POCKET KNIFE.—P. W. HALLVARSON, Black Diamond, Alberta, Canada. The invention has reference more particularly to a pocket knife whose handle is formed from a single sheet of metal folded into parallel legs, of any desired number so that the knife blade or other instruments may be pivoted between adjacent legs, this metal handle also having controlling springs for the knife blades formed integral with the handle.

Heating and Lighting

LANTERN CARRIAGE AND LENS MOUNT.—A. G. HAMMELL, Sr., 529 W. 180th St., New York, N. Y. An object of the invention is to provide a construction which will permit the use of a single lamp for a moving picture machine and for a stereopticon, and which will cause the lamp to be properly positioned for other purposes without an adjustment except the swinging from one position to the other along a prepared and predetermined course.

Machines and Mechanical Devices

GUIDE FOR BOX MACHINES.—J. H. OSTNER, 330 Beta Place, Glendale, L. I., N. Y. This invention pertains more particularly to a means for guiding the blanks from which paper boxes are formed in order that they may be properly presented to the folding mechanism regardless of the condition of said blank. It is a further object to so construct the guide that irregularities in the edge of the blank will not cause mispositioning of the blank with respect to the machine to which it is fed.

COMBINED OIL CUP AND PACKING GLAND.—W. F. SIGLER, 2645 P. St., Lincoln, Neb. An object of the invention is to provide a form of combination oil cup and packing gland, which is designed for use with a mechanism provided with an upright piston rod, and which is provided with means for effectively lubricating the piston rod while also performing the function for which a packing gland is ordinarily employed.

ELEVATOR FOR FRUIT GRADERS AND OTHER PURPOSES.—W. P. THOMAS, Carlton, N. Y. This invention relates to an elevator employing an endless conveyer involving a belt and slats carried thereby. The elevator slats and coacting parts are so formed as to minimize the possibility of the fruit falling therefrom while being elevated; the elevator is so arranged that as a loaded slat approaches the top and starts to turn the fruit or other material falls from the slat and passes over a transverse incline to a grader and sizer.

Medical Devices

MECHANICAL MASSAGING DEVICE.—P. C. DUBE, 608 S. Mary St., Escanaba, Mich. Among the objects of this invention is to provide a device for massaging by mechanical means a number of muscles of the body at the same time, and in a more uniformly effective manner than is possible when the massaging is done manually. A further object is to provide a device that may be adjusted to massage muscles of various sizes.

SURGICAL AND MEDICAL INSTRUMENT.—E. FUCHS, c/o E. Fuchs Patent Mfg. Co., Guadalajara, Mexico. The invention particularly refers to an instrument for electrically treating cavities of the human body. An object is to provide a safe, compact and inexpensive instrument which is so arranged as to receive and carry the source of stored current which is used in the instrument.

Musical Devices

PIANO HAMMER. — C. J. and W. J. PFRIEMER, 781 E. 142nd St., Bronx, N. Y. Among the objects of this invention is to provide a device by means of which the elasticity of the felt, or its equivalent is increased, and to provide a hammer with the felt so secured and fastened as to be entirely free from direct contact with the wood or like material which may form the hammer head or molding directly connected with the piano action.

Prime Movers and Their Accessories

VALVE FOR AIR-COOLED SPARK PLUGS.—J. J. SMITH, JR., 77 W. Napier Ave., Benton Harbor, Mich. Among the objects of the invention is to provide a valve which will act automatically on the intake stroke of the piston of the engine to which the spark plug is applied to permit a stream of cold air to play on the spark plug tips, thereby tending to free the latter of any carbon accumulation, and keeping the spark plug cool.

Railways and Their Accessories

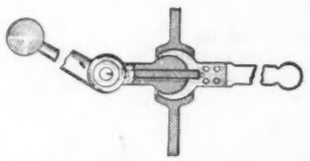
RAILWAY CAR TRUCK PEDESTAL AND JOURNAL BOX.—D. W. ALDERMAN, 2256 Warren Ave., Chicago, Ill. An object of the invention is to provide a journal box and pedestal having means for reducing the wearing of one upon the other to a minimum. A further object is to provide a journal box and pedestal having larger bearing surfaces contacting each other than is ordinarily provided, and is therefore stronger and more durable.

Pertaining to Recreation

FIGURE TOY.—F. A. KOCH, 269 E. 194th St., New York, N. Y. The primary object is to provide a figure toy having pliable limb members, and rigid members simulating hands and feet, and which may be capable of being stood alone and caused to assume grotesque positions in which it may be balanced.

Pertaining to Vehicles

LOCK FOR GEAR SHIFT LEVERS.—O. NELSON, Box 293, Concrete, Wash. This invention relates to gear shift levers for motor vehicles, and has for its object to provide mechanism in connection with levers of this character, for preventing unauthorized use of



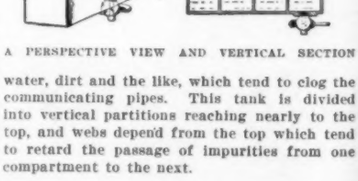
SHOWING THE PARTS IN LOCKED POSITION

the vehicle, when desired, by making it impossible for any one to use the lever to operate the transmission.

PACKAGE HOLDING ATTACHMENT FOR AUTOMOBILES.—M. TEICH, 1382 College Ave., Bronx, New York, N. Y. This invention has for its object to provide a device which is connected to the step of the automobile, which can be secured in operative position above the step, and which can be folded and secured in position under the same. A further object is to provide a casing which supports the holder when under the step, and protects the same from dirt.

TRANSMISSION.—J. W. SANDERS, Jeffersonville, Vt. The invention relates particularly to that class of transmission which is employed in motor vehicles, where it is desirable to realize on a change-speed gearing for developing a slow traction without imposing an undue strain on the motor. The principal feature consists in producing an electro-mechanism whereby the speed may be changed without throwing the clutch out, or in any other way disconnecting the engine shaft from the drive shaft.

GASOLINE PURIFIER.—W. R. HARRIS, 525 Brady Bldg., San Antonio, Texas. The object of this invention is to provide an auxiliary tank adapted to be arranged between the fuel tank and the carburator, for thoroughly removing from the fuel the impurities, such as



A PERSPECTIVE VIEW AND VERTICAL SECTION

water, dirt and the like, which tend to clog the communicating pipes. This tank is divided into vertical partitions reaching nearly to the top, and webs depend from the top which tend to retard the passage of impurities from one compartment to the next.

Designs

DESIGN FOR AN ARTICLE OF MANUFACTURE.—A. H. SELL, 858 S. 13th St., Newark, N. J.

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From the Einstein Contest—IV

(*Continued from page 235*)

no such thing as "really" straight or "really" curved. These are only appearances set up as a consequence of our relative motions with respect to the bodies concerned. If there were no such thing as acceleration—if the stone fell to the earth at uniform velocity—then an observer on the earth or anywhere else would agree that it fell in a straight line: and straight lines would always be straight lines.

Under these circumstances, Euclidean geometry would be absolutely true. But if we are in a state of acceleration, then what we think are straight lines are "really" curved lines, and Euclidean geometry, based on the assumption that its lines are straight, must founder when tested by more accurate measurements. And in point of fact we are in a state of acceleration: for we are being acted upon by a force—namely, the force of gravitation. Wherever there is matter, there is gravitation; wherever there is gravitation there is acceleration; wherever there is acceleration Euclidean geometry is inaccurate. Hence in the space surrounding matter a different geometry holds the field: and bodies in general move through such space in curved lines.

Different parts of space are thus characterized by different geometrical properties. All bodies in the universe proceed on their established courses through space and time. But when they come to distorted geometrical areas, their path naturally seems to us different from when they were moving through less disturbed regions. They exhibit the difference by acquiring an acceleration: and we explain the acceleration by alleging the existence of a force, which we call the force of gravitation. But their motions can in fact be perfectly predicted if we know the geometry of the space through which they are traveling. The predictions so based have in fact proved more accurate than those based on the law of gravitation.

[*"Shinglewood" concludes his essay with a paragraph of peroration, intended to provide a dramatic and oratorical climax. Both the Judges and the Einstein Editor are entirely out of sympathy with this paragraph—not with the idea of introducing such a paragraph, let it be said—but merely with the execution of this particular specimen; and they are agreed that it is so distinctly out of place as to weaken the essay materially. So we have taken the liberty of suppressing it. Otherwise the essay is reproduced intact.*]

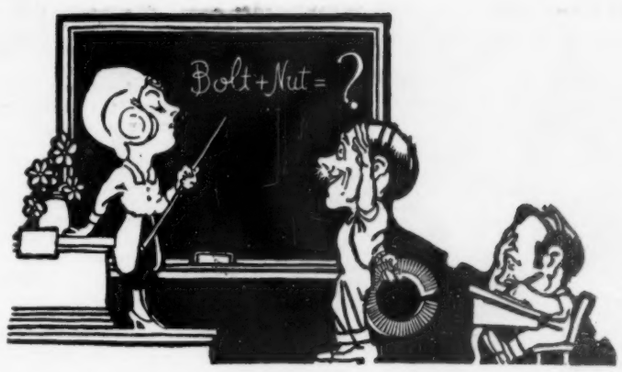
The Balky Motor

(*Continued from page 227*)

through a defective carburetor-flange packing or through leaks in the intake manifold. Water or rust in the gasoline. Valves sticking in their guides. Dirt or poor contact in the secondary distributor. The mixture much to rich. Motor too cold for fuel of low volatility. Spark too far advanced.

If the motor does not run well with wide-open throttle when pulling or if it does not accelerate properly, look for the following: Motor too cold. Low-grade gasoline. Defective spark plug; especially those with the terminals at the spark gap too far apart. Induction coil or condenser broken down inside. If climbing long hills, the vacuum in the inlet manifold may be too low to raise gasoline to the vacuum tank in proper quantities. To remedy this drop back to low gear and partly close throttle occasionally or stop the car entirely, throw out the clutch and run the engine as fast as possible with the throttle not more than half open. Water or dirt in the gasoline. Spark not sufficiently advanced.

If the motor does not run properly at high speed the following faults may be suspected: Spark not far enough advanced; spark plugs in poor condition such as badly carbonized or with excess-



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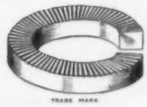

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sively large gaps. Weak valve springs or valves sticking in guides. Too great a clearance between valve operating plungers and valve stems which reduces effective lift. Shortage of gasoline. Ignition contact breaker gap too small or too wide. Pitted or burnt igniter points. Muffler passages stopped up or constricted by carbon and oil deposits. Leak in cylinder head gasket. Dragging emergency brake.

If after the motor is started it will run at high speed but will not run regularly at low or idling speed it may be because: The motor may be too cold. There may be an air leak which permits diluting the mixture through a porous inlet manifold gasket, through poor packing at the flange joints, or around loose inlet valve guides. The valves may not be seating tightly enough or may be held clear of seat by particles of dirt. Badly worn piston rings which permit gas leakage. Spark gap between spark plug points too narrow. Spark too far advanced or timer stuck in advanced position. Gasoline leaking in through the suction connection of the vacuum tank. Throttle shutter may not close properly on account of the stop screw being regulated so the butterfly valve cannot close. In some forms of carburetor such as those of the compound nozzle type in which the idling jet is controlled by the throttle shutter, the valve may be turned the wrong way so it does not close positively and also so it does not control the idling jet. Weak or broken exhaust valve springs, which permit the exhaust valves to open under suction.

If the fuel consumption is excessive it may be due to: A poorly lubricated or overheating motor which does not turn over as freely as it should. Dragging brakes. Spark not sufficiently advanced. Carburetor improperly adjusted such as having jets to give maximum power and acceleration at a sacrifice of economy. Poor setting of dash control regulating air supply to the carburetor. Motor clogged with carbon deposit. Insufficiently inflated pneumatic tires. Wheel bearings adjusted too tightly.

Canada's New Parliament Buildings

(*Continued from page 228*)

and the central court. In the distance leading to the library, a succession of intricately-carved arches stretch, the arches being upheld by columns of cyanite; and in time the niches between the arches will be filled with the marble statues of Canada's most famous men. At the first floor, in this corridor of arches, is the Bridge of Sighs.

A high window at the end of the central court will later be called the memorial window "In Flanders Fields." The lower third of the window will depict the Canadian soldiers wearily waiting and anxious to go into battle. The second, or middle, third will show the warriors in celestial uniforms with pennants blazoning the names of battles in which Canadians played a noble part, while the top third shows the glory of Paradise and the welcome of hovering angels.

Going east along the south corridor one comes to the Senate chamber where the arrangement of the desks is similar to that in the Commons, with the exception that the color is red. Here the richness of the wood and carvings beggars description. The ceiling is paneled in richly coffered octagons in which are painted the emblems of the five countries from which Canada derives her sons and daughters: England, Ireland, Scotland, Wales and France. Again the strip of teakwood and ebony leads to the throne above upon which will be placed a statue of King Alfred the Great, England's first law maker.

Next comes the Governor-General's suite of rooms, separated by arches of beautifully carved oak in which doors are hung. Here are to be found the armorial equipment of Canada's past Governors and above the two doors are the royal crowns of Britain with "G. R." and "M. R." on them, respectively. Above the third and last door three plumes signify the motto of the Prince of Wales, "Ich Dien."

In the Senate railway room are to be seen, in half circles sunk in the wall above doors and windows, paintings showing the progress of travel in Canada—the pioneer trip by water, the first train, the new steel train, the airplane, latest ship, and Canada's four leading industries—farming, fishing, mining and lumbering.

Reaching the basement one sees the arteries and the nerve centers of the whole structure. The floor is ten inches thick of reinforced concrete and a tunnel leads to where three-quarters of a mile away the throbbing power house generates heat for all the buildings on Parliament Hill.

The Romance of Invention—XX

(*Continued from page 230*)

is now used. The enormous increase in the use of the electric wagon, truck and pleasure car, equipped with these batteries, shows the trend of the future."

It was confidently expected by a great many people that Mr. Edison would produce some revolutionary device during the war which would automatically select all the German submarines from other hulls and blow them up, or extract the venom from German natures and bottle it to be used in shells against them, or some other equally remarkable and absurd idea. As a matter of fact Mr. Edison spent two years in Washington working day and night on war problems, and bringing to bear on military situations that resourceful mind and those perfected methods of research which the world knows by their results. It was Mr. Edison who made charts of submarine sinkings and plotted them by days, by hours, by ship lanes, by ports, by light houses until he had deduced some definite rules showing how and when and where a ship was safest from attack—a piece of work of hardly imaginable magnitude, and which, like Columbus's egg trick, seems perfectly obvious once it is done, but which no one but Edison apparently thought to do.

While most of the world of science and invention was devoting attention to the submarine either in endeavors to locate it before it attacked or to prevent its attack from being harmful by protecting attacked ships with nets, screens, false bottoms, water or oil or other material-filled compartments, etc., Mr. Edison was engaged in what proved to be apparently the simplest as it was certainly the most original method of preventing a torpedo from doing damage.

"You can hear a torpedo when it is fired and as it progresses," said Mr. Edison. "There is no way of muffling its sound. Torpedoes, of course, are fired, not at the place the attacked ship is at the moment of firing, but at the place she will be at the time the torpedo meets her line of progress. If, therefore, there was a means of preventing a ship from being where the torpedo-firing submarine calculated she would be, the torpedo would miss.

"With this for a premise I calculated and experimented and devised a method by which a ship, no matter what her size and speed, can change her course to one at right angles with it, in from two-thirds to three-fourths of her length. Such vessels, so equipped, are also provided with submarine listening devices and a man or men always on duty. When the sound of a fired torpedo is heard, the course changing apparatus is put into play and within a few seconds the ship is steaming at right angles.

"Like most efficient devices it is simple—nothing more than huge hawsers, from which are swung very large conical sea anchors. This apparatus is connected to

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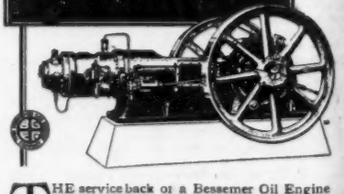

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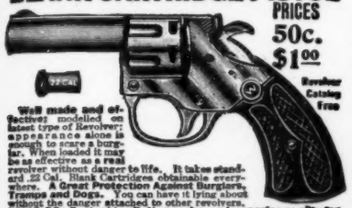

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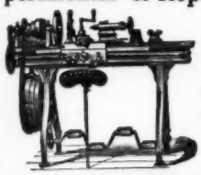

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the bow, not the stern, and when dropped overboard, simply stops the bow while allowing the stern to swing around. The change of course is accomplished in a few hundred feet of water. Water is a yielding medium, in the sense that objects can be dragged through it. The enormous force thus exerted on the vessel is applied gently, and gradually, if quickly. Many people do not realize the part played by the time element in any application of force. There is more energy in a pound of coal than there is in a pound of dynamite. But the former gives up its energy slowly, the latter, all at once. If I stopped one end of a ship instantly—well, it would be like the accident to the Titanic. But had the Titanic been equipped with these bow slung sea anchors, she would have had ample time to swing aside from that berg. Yes, we tested the device on actual vessels and it worked as I knew it would work, but by the time this was ready for service the submarine had been pretty well attended to by other means."

It is common and usual for the newspaper and magazine writers who talk with Mr. Edison to rake up back files of various papers and resurrect the story of Mr. Edison's working all day, and all night and another day and night or so for good measure, and then asking for his breakfast. We have been told of beefsteak dinners in the wee small hours, and the fact that Mr. Edison doesn't need much, if any, sleep, and a great many more similar touches of "human interest." I can find no space for similar details here, because of the impression made upon me by Mr. Edison as a man. Mr. Edison is seventy-four years of age. But he is so vigorous, so alive, so interested in what he is doing that no one about him realizes it, and it is doubtful if he does himself. One of his assistants said to me, "Mr. Edison knows everything there is to know about the phonograph as we built it. There is no detail with which he is not familiar. Yet the commercial building of phonographs is no part of Mr. Edison's personal work, now. He spends most of his time in his laboratories."

Another said to me: "When I came with Mr. Edison I had heard that he 'worked' his assistants very hard. It is absolutely not so. Mr. Edison does not 'work' anyone. You 'work' yourself, because you are intensely interested in what you are doing. He 'works' himself hard because he is vitally interested in what he is doing. But I can't imagine Mr. Edison wanting assistants about him that he had to keep at work. You are either an enthusiast, working with an enthusiast, or you don't work with him."

In going through the factory and meeting and talking with many men, heads of departments, foremen, laboratory workers, workmen, I got a word here, a suggestion there, a hint somewhere else. They were all to the same effect. Mr. Edison is "the old man" to his entire seven thousand employees. It is a term of affection. Mr. Edison has never been too busy to be human, and never too wrapped up in inventing a new machine to forget the needs of the human machines with which he works.

At the moment Mr. Edison is gathering data for an investigation of the ether. "I'm doing this for recreation," he told me. "I am just reading everything on the subject I can find, and finding out what the other fellow has thought and said and published and discovered. I am not at all satisfied that all the present-day thought about the ether is correct. If Einstein can find something new to say about space and time and geometry it may be the last word hasn't been said on the ether. But I couldn't say a word about it now. I haven't data enough. I can't work without data—*all* the data."

At seventy-four, getting ready to formulate some new theory of ether *as a recreation!*

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Making a Forest to Order

(Continued from page 232)

slacked on the spot in heaps covered with earth, is spread before plowing. This assists toward decay of the natural vegetation.

On the flat, at first, water moves slowly sideways through the soil; moreover, as it takes some time to decompose the vegetable matter it has become a practice to leave the land alone for one season before putting in a crop, during which time the preparation of the soil is completed and chemicals are applied. The chemicals mostly used are raw phosphates or basic slag, but very often it is equally necessary to give potash. Where the soil is devoid of humus it is advisable to apply the latter shortly before sowing the green manure crop. The quantity of chemicals used vary very much; they are harrowed in.

For preference yellow lupins are grown as green manures whenever possible, under temperate climes, one cwt. of seed being sown to the acre. It is advisable to inoculate the land with about 4 cartloads of earth from a field which has grown lupins the year before, else not infrequently the first crop fails and it becomes necessary to grow a second lupin crop which adds considerably to the cost and delays the work one year. Yellow lupins stand drought well, grow quickly and yield a bulkier crop than blue lupins; moreover, they have the advantage over the latter of not being fit for food, in which case the essentials to the improvement might unwisely be taken away.

Where late frosts are to be feared sowing must not be done before May 15th, rolled and left alone until they are plowed in when fully in flower. To develop a strong lupin crop and get the full advantage of their use, more chemicals are applied than are required by the woods so that the expense incurred is higher than necessary to the ultimate object. Therefore one farm crop is generally taken without any chemicals except perhaps a little nitrate of soda. For preference a winter corn crop which can be sown early, thanks to the early readiness of the land, is taken. Sometimes also a second corn crop is grown. In this case yellow lupins are broadcasted in the first corn crop about the time when ears are coming out. Then the plants of lupins, which have the habit of spreading their first branches flat on the ground, will not be cut at harvest time, but will be ready to cover the field at once. The lupins are plowed in before the first frosts. When a second corn crop is grown, sometimes serradella is also sown into the first crop. It is sown in April and rolled. This will yield valuable green food. When only one farm crop is taken no intercropping is done, but firs or spruces are planted in the corn. This may be done as soon as the soil is settled, from December onward. This again is a very interesting practice: Young plants are used, they are sheltered by the crop, and one year is gained in growth and on the invasion of weeds. It is essential that plants should be small, else they would be cut at harvest time. For planting, an ordinary spade makes a slit, and the plant is fixed firmly into the soil by the pressure of the foot. The first row is planted by a string on which the distances apart are marked, the other rows are slit at sight, the outside position being paced off. This is an extremely quick process. During the planting season of December last, which corresponds to the shortest days of the year, an average of between 8,000 and 9,000 one-year-old firs were planted a day by a gang of men. An ordinary gang is composed of one slitter and two boy planters. The average above mentioned included besides planting, the lifting from the nursery, counting and bundling the plants, and covered the delay for wet weather as well. On one particular day one slitter and three boy planters put in 18,000 plants (no lifting, no rain). Last April an experienced slitter, who was recommended not to overdo it, made 1,800 slits an hour at his ease in land covered with poor grass.

Such varieties of trees as can be raised from seed and left on the spot are sometimes sown in the corn. They are simply rolled. This practice, too, saves one year.

Deciduous plants or bigger conifer√¶ are generally planted the season after the crop has been cut, but here again younger and untransplanted one- or two-year-old seedlings are being used. At the next opportunity even we shall plant into the corn deciduous seedlings for underwood, only filling the following season the plants which are to become trees. The introduction of this system will open a new era for forestry in many countries, and it is likely to be generalized as soon as its advantages are realized.

Curious Habits of Lampreys

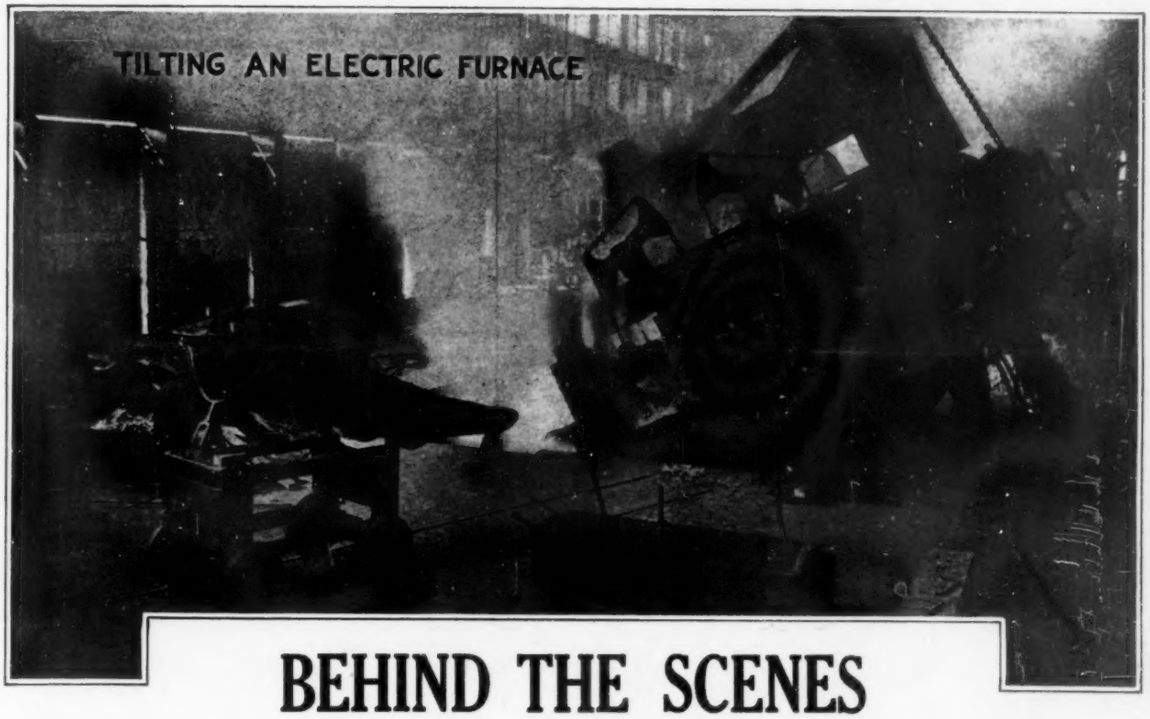
(Continued from page 233)

and toothless. They are indeed, so strikingly different from the adult form that they were long thought to be an entirely different species, and received the distinct name of *Ammocoetes*. These larvae live in burrows in sand at the bottom of the water. Those in the lakes in Central New York metamorphose, assuming the adult form, in the latter part of the fall. At this time they are about six or eight inches long, the externally segmented condition of the body disappears and the eyes appear to grow out through the skin. The mouth, which in the larva was filled with vertical membranes acting as a sieve, now changes the deadly instrument described above.

Lampreys are very particular in choosing places to spawn. They select comparatively shallow water in the bed of a stream and it is a *sine qua non* that the bottom must contain both stones and sand. Here a nest is built by the simple process of clearing the stones from a certain area of the bottom, so as to form a basin having a sandy bottom and surrounded by a rampart of stones. In the case of the lake lamprey, this basin is about the size of a common wash bowl, but in the accompanying illustration, which shows the nest made by a sea lamprey it is much larger, being 4 x 5 feet. This picture is taken from an exhibition group in the American Museum of Natural History and was prepared under the direction of Dr. L. Hussakof from studies made by him on Nissequogue River of Long Island, near Smithtown. In this stream Dr. Hussakof found numerous lamprey nests.

Our second illustration is taken from a remarkable photograph made at the picturesque Dalles of the Columbia River in Oregon. This was recently described to the writer by Dr. J. T. Nichols of the American Museum of Natural History. According to this authority lampreys are not very strong swimmers and, accordingly, make their way along the edges of rivers where the current is less strong, and where there are rocks to which they can cling when tired. In this instance instead of breasting the current of the fall, they apparently thought it was easier to climb up along the bare surface of the precipitous but not very high wall at its side. This they accomplished by a sort of wriggling motion, keeping the mouth attached to the rock and gradually working their way upward until by a final flop they were either able to land on top or else fell back to the bottom. Sometimes, too, they are said to make a series of short jumps attaching the mouth after each one.

Lampreys are wholesome food and were much prized by the Romans, especially when stewed in wine. Henry I. of England is said to have died of a surfeit of them. However, they are considered rather indigestible, and some persons find the snake-like shape repellent.—By *M. Tevis.*



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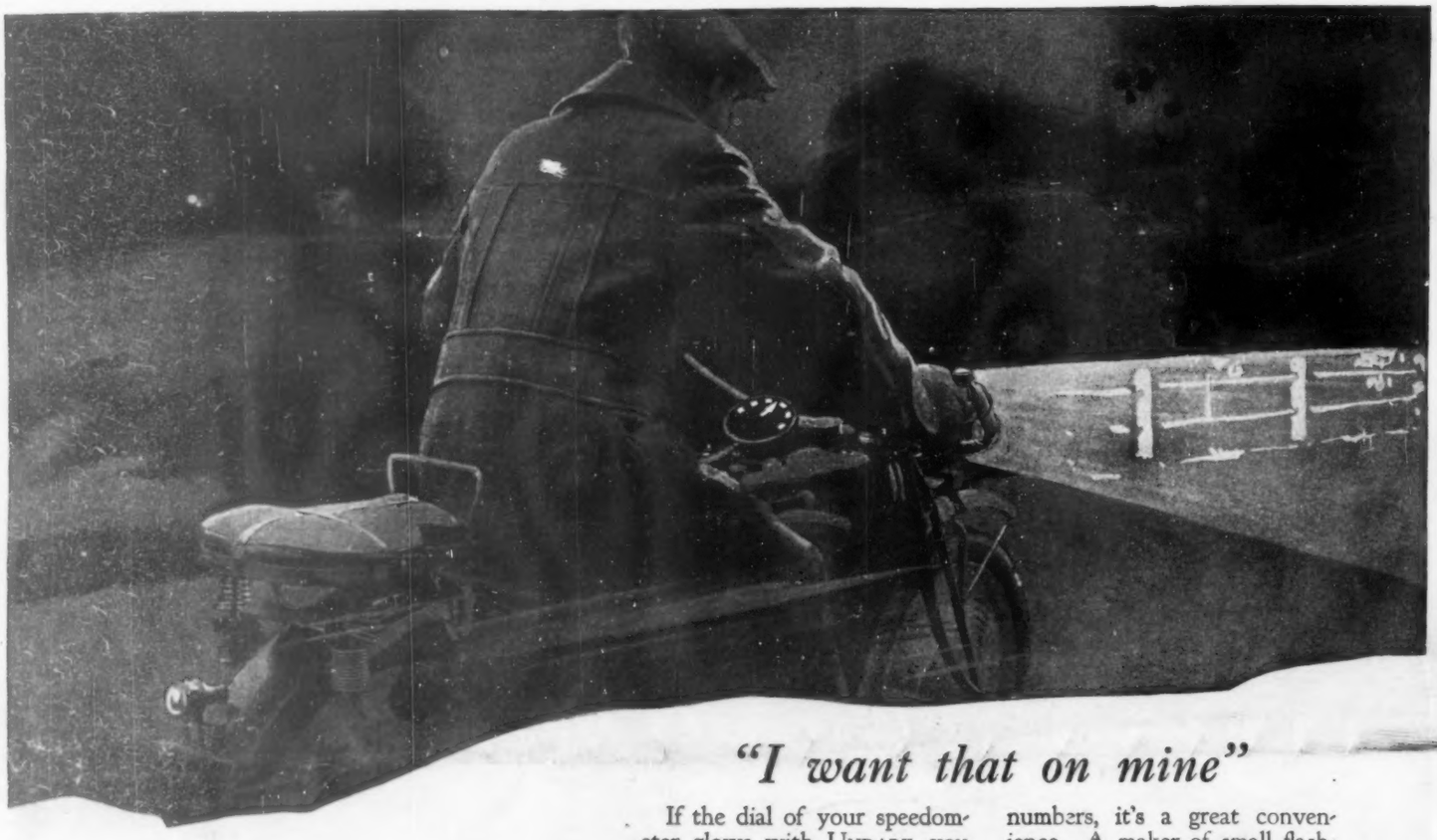

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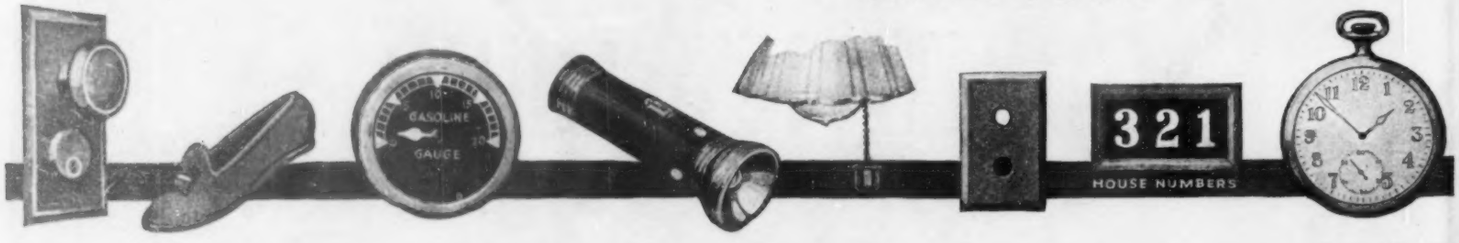
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